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International Marine Engineering

JANUARY, 1910.

THE SIX-MASTED SCHOONER WYOMING.

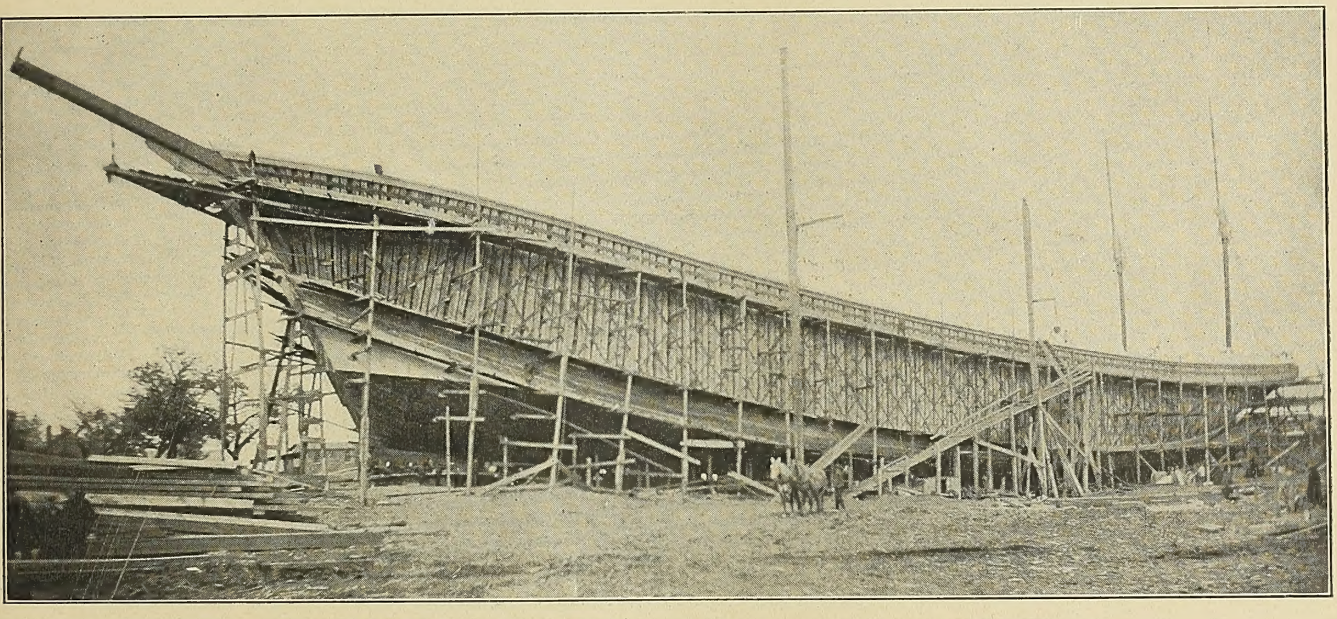
Bath, Me., has demonstrated her supremacy in marine construction in many forms and on many occasions, but the product which first brought fame to the city was the wooden sailing vessel. Although in recent years some of the largest and fastest steel warships in the United States navy have been turned out from her yards, still the work of building wooden sailing vessels goes on, and each year magnificent vessels of this type sail proudly down the Kennebec to join the already large fleet of Bath-built ships engaged in the coasting trade.

The six-masted schooner *Wyoming*, launched from the yards of Percy & Small, Bath, Me., on December 15, is the crowning specimen of the original Bath product, as she is the largest wooden sailing vessel that ever floated. The *Wyoming* is 350 feet in length over all and 304 feet on the keel. She is 30 feet deep and 50 feet beam. About 1,500,000 feet of hard pine was used in the construction of the hull.

The six lower masts are of Oregon pine, 126 feet long and 30 inches in diameter. They are spaced 44 feet 6 inches apart. The topmasts surmounting these are 56 feet long. The spanker boom has a length of 80 feet, the jib boom 75 feet and the bow sprit 52 feet.

The hull is ceiled with 14-inch yellow pine and planked with the same material. The frame is of Virginia white oak, molded 16 inches at the keel and tapering to 8 inches at the top; sided 14 inches. The keel is of the best of oak, in two tiers each 14 by 15 inches. As shown in the accompanying midship section, the keelson is in six tiers, each 14 by 14 inches, with sister keelsons, each four tiers deep of the same size timber.

The beams are 13 inches by 14 inches in the lower hold, the main deck beams are 11 inches by 12 inches, and the upper deck beams 9 inches by 13 inches. The ceiling in the poop is 11 inches and 14 inches. The lock strakes in the lower hold are 12 inches by 14 inches, two strakes, and the between-deck waterways are 12 inches by 14 inches two strakes The stanchions in the lower hold are 13 inches by 14 inches and between decks 11 inches by 13 inches. No hanging knees are used in the construction of the vessel. There is one shelf strake 14 inches by 14 inches in the lower hold; one shelf strake between decks 14 inches by 14 inches and one under the poop deck 14 inches by 14 inches.



THE LARGEST WOODEN SAILING VESSEL EVER BUILT. NOTE THE DIAGONAL BRACING OF THE HULL.

The upper deck is planked with white pine 3½ inches by 4½ inches, the middle and lower decks are of 3-inch by 5-inch hard pine. The plank shear is 6 inches by 15 inches. The two lock strakes are 8 inches by 12 inches and 9 inches by 12 inches. The upper deck is in one unbroken sweep from stem to stern, with none of the depressions and enclosed areas that fill with water and become nuisances in rough weather. Furthermore, the flush deck has the merit of giving added strength.

The planking consists of three garboard strakes 8 inches by 14 inches, the remainder being 6 inches by 14 inches down to 6½ at the gunwale. The fly rail is 5½ inches by 11 inches. The outside fastening is of oak below the waterline, and of locust above the load waterline.

There are five hatches, those in the upper deck being 12 feet by 18 feet, and those in the lower decks 12 feet by 13 feet. Only galvanized iron is used on deck.

The quarters forward, as well as aft, are very commodious,

and for a merchantman even luxurious. The after house is 30 feet by 36 feet, and contains two saloons, the captain's room, the mate's room, a pantry, bathroom, chart room and medicine department. The cabins are paneled in quartered oak, mahogany and bird's-eye maple. A combination of white spruce and cypress forms a striking effect inthe overhead work. The captain's room is finished similarly to the cabins. There is a house aft of the main mast 20 feet by 28 feet containing the galley, mess room, steward's room, second mate's room and carpenter shop. The forward house is 18 feet by 28 feet and contains the engine room, the engineer's room and forecastle. The forecastle has accommodations for eight sailors. These quarters are all finished in North Carolina pine and are steam heated.

Three boats are carried by the schooner, a 26-foot ship's yawl with a 10-horsepower Kennebec engine, a 16-foot boat and a 12-foot skiff.

The hull is reinforced by a wrought iron belt strap 8 inches by ½ inch, and a system of diagonal belt strapping throughout 4 inches by ½ inch, as shown by the photograph taken during the construction. This method of strengthening has been exploited with highly favorable results during the past few years in several of the larger wooden schooners. It has proved to be the most effective means of keeping the long and otherwise flexible hulls in shape.

In competition with the invading barges and steam colliers, the *Wyoming* will spread 12,000 yards of canvas. She is equipped with a Hyde No. 13 windlass. Two Balt stockless anchors weighing 8,500 pounds each are furnished at the ends of 240 fathoms of 2¾-inch Bradley chain.

The hull is salted throughout between planking and ceiling, six hundred hogsheads being used for the purpose.

The *Wyoming* registers 3,730 gross tons, and is classed A1 for sixteen years. She will carry 6,000 tons of coal, a cargo which is equal to the capacity of eight or ten of the average three-masted coasters.

The schooner was designed by Bant Hanson, and is the splendid product of long years of experience in this line. The master builder was Miles M. Merry, who holds the tonnage record for square riggers as well as for fore and aft vessels. It was he who built the ship *Roanoke* for the Sewallc some eighteen years ago, which was the largest ship ever built of wood.

LAUNCH OF THE SIX-MASTED SCHOONER WYOMING.

The *Wyoming* will engage in the Atlantic coasting trade under the Percy & Small flag, and under the command of Captain Angus McLeod, formerly of the five-master *Governor Brooks*.

We are indebted to the Stevens Bros., Bath, Me., for the photographs and description of this vessel.

Launch of the Battleship Utah.

The fifth American Dreadnought, the battleship *Utah,* was successfully launched from the yards of the New York Shipbuilding Company, Camden, N. J., December 23. A record was established by launching the boat nine months and eight days after laying the keel. The nearest approach to this was in the construction of the *North Dakota,* which was launched in ten and three-quarters months from the date of laying the keel. The *Utah* is 551 feet 6 inches long over all and 510 feet long on the waterline. Her beam is 88 feet 2 inches, and her displacement 21,855 tons.

THE TREATMENT OF MARINE BOILERS ON LONG VOYAGES.*

BY H. RUCK-KEENE.

The boilers should always be thoroughly cleaned and all scale or deposits on the heating surface removed. A sufficient quantity of zinc plates should be securely attached by studs to the furnace sides, and also to any other part of the boilers where there is any sign of corrosive action. Clean, fresh water —and fresh water only—should be used for first filling the boiler and for make-up feed, and the feed water should be heated up to about the temperature of the boilers before it is passed into the boilers, as the use of heated feed water is thought by some to increase the evaporative efficiency of the boiler, and certainly reduces the strains which must be set up when cold feed water is used. Every precaution should be taken to prevent the entry of air into the boiler along with the feed water.

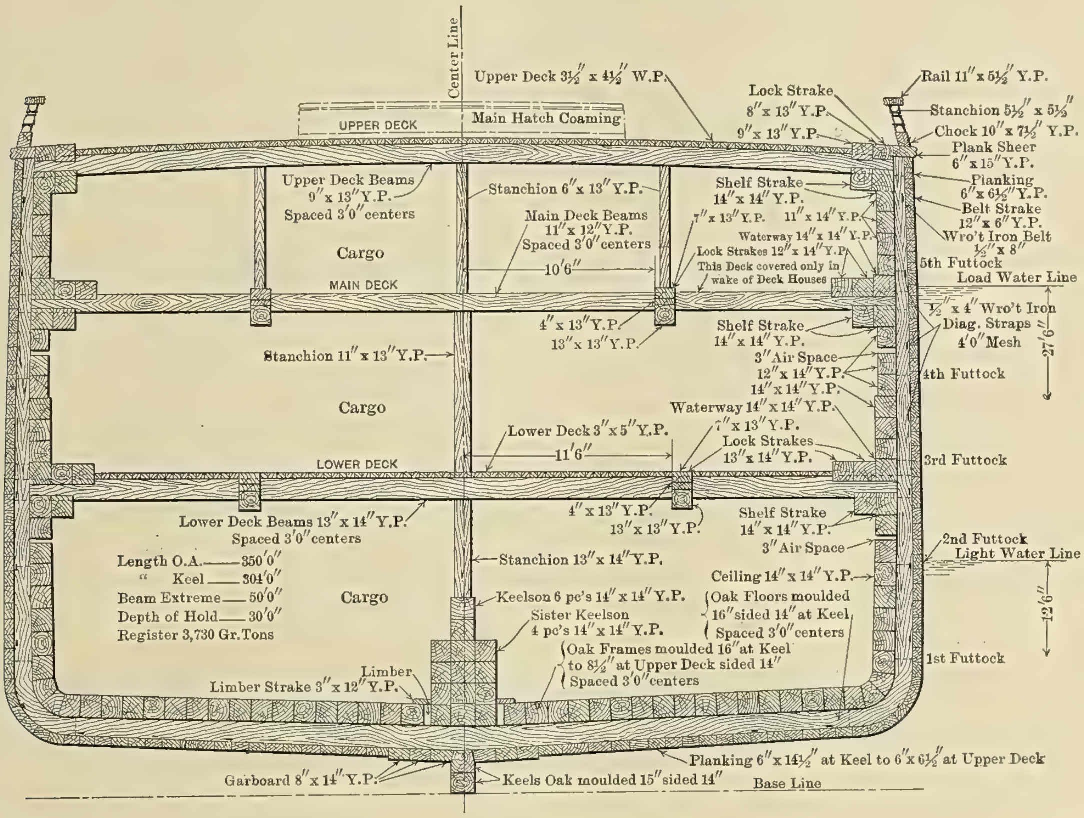
Some engineers still advocate the use of a small amount of sea water when first filling the boilers, especially in new boilers, so that a slight scale may be formed on the inside of the boilers, maintaining that by such treatment corrosion is avoided. But as the formation of even a slight scale on the heating surfaces must tend not only to the overheating of these parts, but also to an increased expenditure of coal in proportion to the water evaporated, it is questionable whether this is a good practice.

Especial care must be taken during the voyage to keep all sea water out of the boiler. For this the use of fresh water for the make-up feed is essential. And fresh water must either be carried in the ballast tanks, or, as is now the usual practice in most vessels running long voyages, efficient evaporators must be fitted to provide sufficient fresh water for this purpose, and they must be sufficiently large to work to the required capacity without priming. A certain amount of sea water will, however, be passed into the boilers if the condenser is leaking, whatever means may be provided for the make-up feed, but such a leak should be stopped as soon as possible. To ensure this, the condition of the feed water as it leaves the hot-well should be regularly and carefully ascertained, in order that the very first discernible leakage of sea water should be known and promptly dealt with. These remarks also apply to the condensers of refrigerating or other auxiliary machinery using steam from the main boilers. In no case should the density of the water be allowed to exceed 1.09 or 3/32.

The question as to how often the water in the boilers should be changed must depend on circumstances, chiefly on how the density of the water has been kept. On long ocean voyages it may be impossible to make any examinations, but it may sometimes be possible to change the water in part of the boilers at coaling ports, even although the stay in port is short.

To avoid unnecessary risks it is advisable to change the water frequently and examine the interior of the boilers, more especially in the case of new boilers.

In some vessels running out to China and Japan, whose boilers I at one time surveyed annually and often at intervals of six or seven months, the water was regularly changed only at the end of voyage out or home, say after about fifty days'



MIDSHIP SECTION OF THE WYOMING.

* From a paper read before the Institute of Marine Engineers, September, 1909.

steaming. And though these boilers were from six to eight years old, they had never required the use of a boiler maker for repairs, nor had a scaling hammer ever been used in them, brushing and washing down being all they required when opened out. These boilers were worked under natural draft and were amply large for their work, and consequently were never forced. Fresh water was always used in filling them, and great care taken to prevent any air in solution being pumped into the boilers. All feed water was heated by means of feed heaters, and also passed through filters, and ample evaporators were fitted for feed make-up, zinc plates being also used to prevent corrosion, of which I may add there was no sign.

Other boilers which I have examined and found to be in good condition are continuously under steam for about forty-two days at a time before the water is changed. Others I believe run for twice that time without changing the water, with satisfactory results, but, generally speaking, for vessels running for such long-distance voyages as to Japan, Australia or New Zealand, even when the density has not exceeded 3/32, it appears advisable to change the water at each end of the voyage.

Great care should be taken at all times, more especially when raising steam, to prevent quick variations of temperature and consequent strains being set up in boilers, as these are often the cause of leaky seams, and of the cracking of the furnace saddle plates and combustion chamber plating. To avoid such strains, at least twelve hours, and better still, twenty-four hours, should be allowed for raising steam in the boilers.

Some engineers prefer to light all the fires at once when commencing to raise steam, others light the wing fires only, and others again light only the center fire. The first plan appears to me to be the best method, as by so doing the heat, being gradually generated in all the furnaces alike, enables the boiler to expand more equally. During this process of raising steam the water in the boiler must be kept in circulation, so as to obtain, as far as possible, an equal temperature of water throughout the boiler. There are many methods of effecting this, one of the simplest and most effective being by pumping the water from the bottom of the boiler and delivering it back into the boiler through the feed pipes, having first heated it in the feed heater by steam from an auxiliary boiler.

There does not appear to be a concurrence of opinion as to the best position in the boiler for the feed water to be delivered, but in every case care should be taken that the incoming feed water does not impinge directly on the plating or tubes, for should there be any air in the feed water, acute corrosion will probably be set up on that part of the boiler against which it impinges. Probably the best position is as near the surface of the water as possible, so that any air which may be in the feed finds its way directly into the steam space.

The best hydrocarbon oils only, of a high specific gravity and high vaporizing point, should be used for the internal lubrication of the cylinders and slide valves, and the amount used should be reduced to the minimum possible. It is now generally found that the swabbing of the piston and slide rods is sufficient for internal lubrication, except in new engines or in some cases where the working surface of the valves is limited, or where a cylinder has been bored out, or a slide valve planed up and not yet worked up to good surfaces.

When electric light engines or fan engines are fitted and their crankshafts are run in oil baths, extra precautions must be taken to prevent an excess of oil being splashed on to the piston and slide rods, as trouble has often occurred through oil getting into the boilers through this cause. Even when internal lubrication is reduced to a minimum every possible means should be taken to prevent oil entering the boilers, and feed filters are now generally fitted for this purpose.

When forced draft is employed care should be taken to prevent an excessive air pressure in the ash-pits and furnaces. This is often due to the speed of the fan not being reduced when the air valves are closed on one or more of the furnaces, when cleaning fires. Keeping the fire-bars well and uniformly covered and the bridges intact are also important points, not only in preventing extra strains being set up in the boilers, but also in ensuring that the air supply is evenly distributed to the whole of the fire on the grate, thus ensuring a more perfect and economical combustion of the fuel.

At the end of a voyage the fires should be allowed to die out in place, and the boilers allowed to cool down gradually, say for about twelve hours, with dampers shut, to prevent any undue strains being set up, due to rapid cooling of certain parts of the boilers.

The blow-down cocks should only be opened for a few seconds to see that they are in working order. After the boilers have been cooled down they should be pumped out and thoroughly cleaned.

THE DESIGN OF REVERSING ENGINES.

BY EDWARD M. BRAGG, S. B.

CALCULATIONS.

In the chapter on "Marine Engine Design" the calculations were carried through for an engine working under the following conditions:

Indicated horsepower = 3,000.

Piston speed = 850 feet per minute.

Boiler pressure = 185 pounds gage.

Cylinder sizes and stroke, 23½ inches, 41 inches, 64 inches by 42 inches.

Eccentricity, 4.25 inches on the high and intermediate-pressure cylinders; 4.75 inches on the low-pressure.

The reversing engine was placed between the low-pressure and intermediate-pressure gears, and the twisting moment from the low-pressure gear was 210,000 inch pounds. This was obtained by taking into consideration the weight, inertia and friction of the low-pressure valves. It was assumed that if the engine were in such a position that the maximum power had to be exerted to reverse the low-pressure gear the other two gears would be in a better position, and only the same amount of power would be necessary to reverse both the high-pressure and medium-pressure gears.

The twisting moment that the reverse engine cylinder must exert will then be 420,000 inch pounds. We will take the stroke of the engine to be

$$2.5 \times 8.5 = 21.25; \text{ use } 21 \text{ inches.}$$

Since the reverse levers were designed to move through an angle of 75 degrees, the length of the reversing engine lever will be, by formula (1):

$$l = \frac{21}{2 \times .61} = 17.2; \text{ use } 17.25 \text{ inches.}$$

$$\frac{420{,}000}{17.25} = 24{,}350 \text{ pounds,}$$

the force that must act upon the pin of the reversing engine lever. Assume the back pressure in the cylinder to be 10 pounds absolute:

$$200 \times .9 - 10 = 170 \text{ pounds per square inch.}$$

$$\frac{24{,}350}{170} = 143.3 \text{ square inches} = \text{area of piston.}$$

A diameter of 13.53 inches will give this area; use a 14-inch

cylinder. The reversing engine will be 14 inches by 21 inches. Since the diameter of the low-pressure cylinder is 64 inches this makes the cylinder of the reversing engine .219 times the low-pressure diameter.

PISTON ROD.

The length of rod will be about 21 + 14 = 35 inches.

By formula (2):

$$F = \frac{2 \times 24{,}350}{\pi \times 4{,}000} = 3.88$$

$$D^2 = \sqrt{\frac{.48 \times 3.88 \times 60{,}000 \times 35^2}{10{,}000{,}000}} + 15.05 + 3.88$$

$D = 3.04$; use 3 inches.

CONNECTING ROD.

Since no oil cylinder is to be used on this gear the length of the connecting rod can be about

$17.25 \times 2.5 = 43.4$; use 42 inches.

By formula (3):

$$F = \frac{2 \times 24{,}350}{\pi \times 5{,}000} = 3.1$$

$$D^2 = \sqrt{\frac{1.08 \times 3.1 \times 60{,}000 \times 42^2}{10{,}000{,}000}} + 9.6 + 3.1$$

$D = 3.14$; use 3.25 inches.

Diameter at ends $= 3.25 \times .85 = 2.76$; use 2.75 inches.

CROSSHEAD GUIDE.

By formula (4):

$$w = \frac{17.25 - \sqrt{17.25^2 - 10.5^2}}{2 \times 42} \times 24{,}350 = 1{,}030 \text{ pounds.}$$

The length of guide from center to center of supports will be about the same as the length of the piston rod.

$$M = \frac{W\,l}{4} = \frac{1{,}030 \times 35}{4} = 9{,}000$$

For a beam of round section $D = \sqrt[3]{\dfrac{M \;10.2}{f}}$

$$D = \sqrt[3]{\frac{9{,}000 \times 10.2}{5{,}000}} = 2.64; \text{ use 2.75 inches diameter.}$$

$$\text{Length of slipper} = \frac{1{,}030}{2.75 \times 70} = 5.36; \text{ use 5.5 inches.}$$

$$\text{Surface of crosshead pin} = \frac{24{,}350}{3{,}000} = 8.12 \text{ square inches.}$$

Length of bearing surface of pin = diameter of connecting rod at upper end = 2.75 inches:

$$\frac{8.12}{2.75} = 2.95; \text{ use 3 inches diameter.}$$

If the All-round type of gear is used the proportions will be as given below. Assume r to be 19 inches.

From formula (10):

$$p = \sqrt{\frac{6.3 \times 420{,}000 \times 10.5}{4{,}000 \times 2 \times 17.25 \times 19}} = 3.22; \text{ use 3.25 inches.}$$

$$n = \frac{2\;\pi\;10}{3.25} = 36.7; \text{ use 37 inches.}$$

$$r = \frac{37 \times 3.25}{2\;\pi} = 19.15 \text{ inches.}$$

We will use steam at boiler pressure for the engine, and assume the *m. e. p.* to be .8 the absolute pressure; *m. e. p.* = $200 \times .8 = 160$ pounds.

From formula (6):

$$d^2\,s = \frac{4 \times 420{,}000 \times 10.5}{17.25 \times 160 \times 37 \times .4 \times .8} = 540$$

Let $s = 6$ inches, $d^2 = 90$ inches. Use two cylinders 6.75 inches diameter by 6-inch stroke.

The proportions of the worm, worm wheel and shaft can be found in the same way as those for the turning engine. The length of the connecting rod will be determined by the position of the worm wheel. The size of the connecting rod and of the pins can be determined by the rules already given.

SOME SPECIAL MACHINE TOOLS USED IN SHIP CONSTRUCTION.

BY E. C. AMOS, M. I. MECH. E.

It is not proposed in this brief article to attempt to deal with all the machinery used in ship construction, but to describe and illustrate a few of the latest types of machine tools used in modern ship work and in the construction of marine reciprocating engines and turbines. Specialization has now become so general that it is difficult to find any machine tool to-day that does not claim to be special, and consequently the old terms of lathe, planer, drill, etc., cease to carry any real meaning unless prefixed by one or more adjectives to define their special features. Instead of demanding an infinite variety of work from one machine we are to-day using an infinite variety of machines, each of which performs one operation on the same piece of work. This is expressing the situation in an exaggerated way, but it is approximately true.

One of the most important operations in a dockyard is the formation of the frames to which the plates are riveted. Frames have to be bent in a variety of curves, while those at the bow and stern must also be splayed and closed. Many of the curves are parabolic and irregular, and hand-work still enters very largely into the process. There yet remains to be designed a machine which will cold-bend to any curve without waste and will at the same time "open bevel" and "close bevel." It is a difficult requirement to meet, but the writer believes that the great need of such a machine will in time produce it.

BEVELING MACHINE.

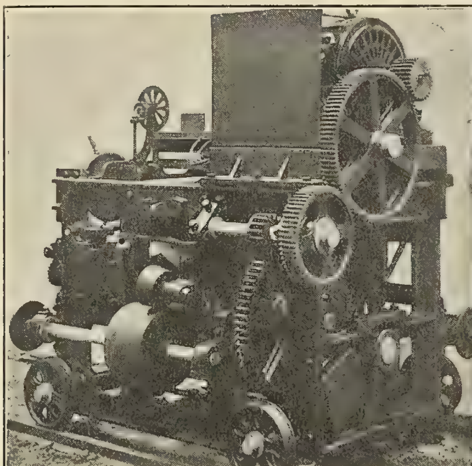
For the purpose of beveling only, however, there are machines such as the Davis beveling machine, Fig. 1. This machine will deal with angle-bars up to 7 inches by 5 inches by 9/16 inch thick; or, provided the narrow flange is always the standing flange as the bar passes through the machine, it will bevel angle-bars up to 9 inches by 5 inches by 9/16 inch. It will also treat zee sections 6 to 8 inches broad by 4 inches deep, and channel sections 6 inches by 3 inches by 9/16 inch to 8 inches by 4 inches by 9/16 inch; also certain sizes of bulb angles and zee bars to any required angle from 90 to 135 degrees, and shut bevel from 90 to 60 degrees. It will bevel channel sections to about 30 degrees from the square.

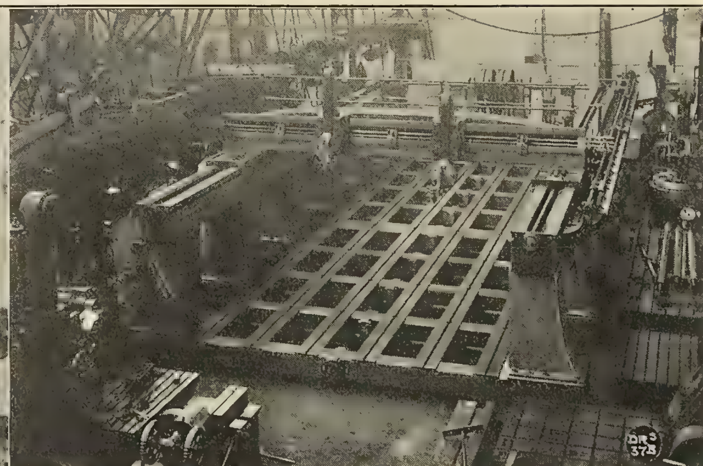
It is hardly necessary to elaborate on the advantages of such a machine over hand labor for the purposes named. The actual results obtained show a saving of at least 50 percent over hand labor. In the first place, there is no guessing at the angle, as the machine can be correctly set for this, and since its action is positive the work can be carried out in one heat. With hand beveling several heats are generally necessary, and consequently the metal becomes brittle, the flanges hollow and the edges unfair, even if the material does not become burnt, which is often the case. This machine draws the bar out of the furnace and effects the beveling when the bar is at its best

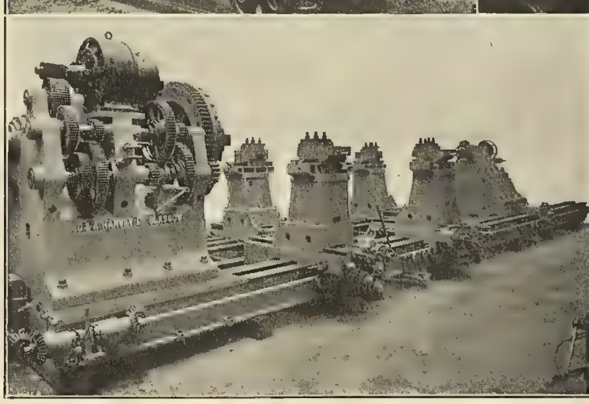
heat. Moreover, since the work is done in rollers when it is hot the edges of the bar remain clean while the rough edges of the rivet holes are smoothed down.

For frame and other work to be done by the machine, the bevels are taken from the body plan of the ship at regular intervals along the bar, the spot numbered; as usual, the angle at each number or spot is measured, and the numbers transferred to the corresponding angles on the bevel board. On the machine is what is termed the bevel index, which is graduated in degrees from 90 to 45. The angles which have been marked on the bevel board are then indicated by their numbers on the bevel index of the machine, in their relative positions, measuring from the end of the bar.

when the feed levers on the saddle come into contact with the stops, thus enabling the machine to be stopped or started by hand in either direction without putting on the feed. The reversing mechanism is operated from a platform placed at the back of the cross-arm by a lever having a sector on the lower portion of it, which gears with a pinion on the square reversing shaft. On the end of this square shaft is another pinion, which gears with a sector and lever connected to a plate which has scroll slots cut in it to receive rollers on the belt forks. There are two belts for driving the machine when on the cutting stroke and two for the return stroke, to obviate the use of wide belts, which are not easily moved from one pulley to the other.







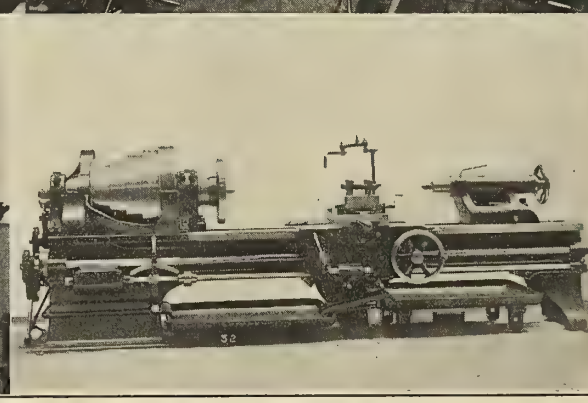


FIG. 1.—DAVIS BEVELING MACHINE.
FIG. 2.—LARGE TURBINE PLANER.
FIG. 3.—LATHE FOR TURNING TURBINE ROTORS.
FIG. 4.—HIGH-SPEED REDMAN LATHE.

TURBINE PLANING MACHINE.

Fig. 2 shows a large turbine planing machine capable of planing across the top of the work 14 feet wide and down the sides of work 12 feet wide, and capable of receiving work under the tools 7 feet deep by 30 feet long. The machine consists of two beds, each 36 feet 9 inches long, having a sliding saddle, in which is mounted a cross-arm or slide. These beds are of heavy section, the distance between them being 14 feet 2 inches. They are supported by legs, which rest on a heavy girder base-plate 20 feet wide by 12 inches deep, extending the entire length of the machine. The cross-arm is driven backwards and forwards by pulleys and bevel gears, which actuate two 4-inch steel screws in the beds and give a cutting stroke of 35 feet per minute in either direction. On the cross-arm are mounted two tool slides carrying the tool rams, which can be swiveled to any angle, and which have a down-feed of 30 inches in all positions.

The reversing mechanism to the cross-arm is quite independent of the feed arrangement, and the feed is only put on

Along the side of the bed is a rail, which carries the feed and reversing stops and sliding bearings for the square feed and reversing shafts. These bearings are pushed along the rail by the saddle, and are so arranged that the shafts are always supported about half-way when the saddles are at the ends of the beds. The feed is operated by stops secured to the rail along the side of the bed, which, coming in contact with the feed levers, bring the clutch on the square shaft into gear, causing the feed disc to revolve, and through the feed levers move the feed pawl either forward or backward, according to the direction in which the cross-arm is traveling.

The feed mechanism is so arranged that the feed can be put on either at the cutting end of the stroke or at the return end, or at both ends. The feed is varied by means of a plate at the side of the feed gear and a catch piece fixed to the feed pawl. To obtain the maximum feed, the plate is turned, by means of a thumb wheel and pinion, to such a position that the recessed part of the plate occupies the arc made by the feed pawl, and the catch piece is therefore not affected by the plate, as the

pawl is in gear from the commencement of its stroke. To shorten the feed the plate is placed in such a position that the catch piece which is attached to the feed pawl rides on the top of the feed plate until it comes opposite the recessed portion, when it allows the pawl to drop into gear and put on the feed. The maximum feed is 1 inch and the minimum feed 1/24 inch. For broad cutting, which, of course, is done with the machine cutting in one direction only, a feed up to 2 inches can be obtained.

The total weight of the machine is 75 tons, and it is adapted for taking heavy cuts running at high speeds.

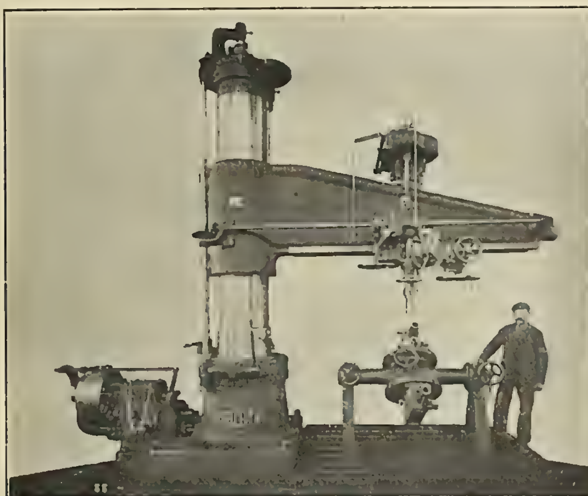
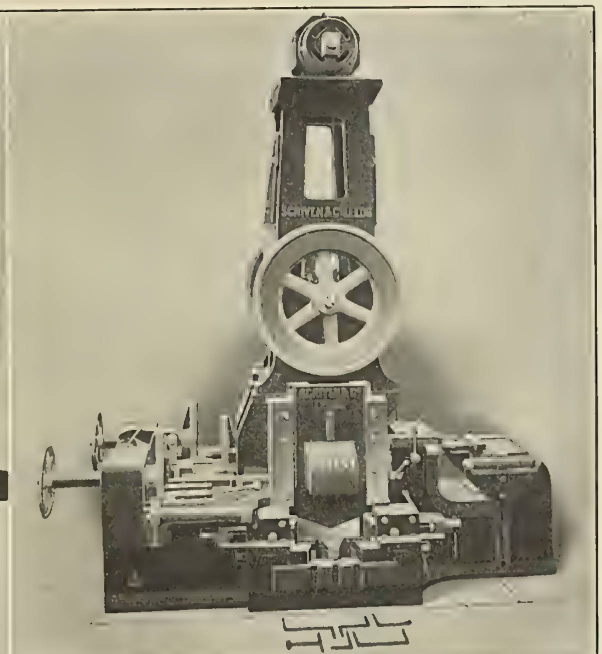
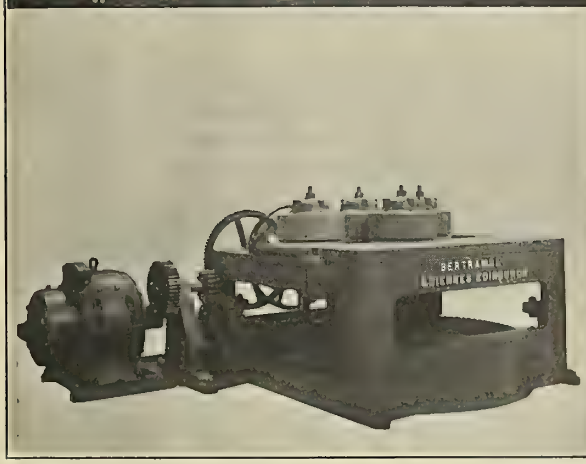
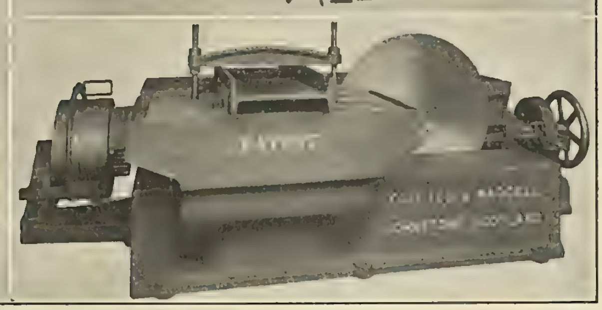





FIG. 5.—ASQUITH RADIAL DRILL.
FIG. 7.—VERTICAL ANGLE BENDER.
FIG. 6.—PUNCHING AND SHEARING MACHINE FOR SPECIAL SHAPES.
FIG. 8.—COLD SAWING MACHINE.

LATHES FOR SPECIAL PURPOSES.

Fig. 3 shows another powerful machine also used in turbine construction. This lathe has been specially designed for turning large turbine rotors and for tipping the blades of same. It weighs 165 tons and will admit 15 feet diameter over the bed by 50 feet between the centers. When driven by a variable speed motor giving eight changes of speed, it is possible to obtain thirty-two changes of speed on the lathe spindle, as the headstock is quadruple geared. The double bed is provided with two front and two back independent saddles, having compound-swiveling slides. The machine is designed for screw cutting, and will also cut long and short tapers. While this machine is specially suited for turbine work it can also be usefully employed for turning heavy shafting, surfacing and screw cutting for general purposes.

A lathe of smaller dimensions, but one equally important in a machine shop, is the 10½-inch center high-speed Redman lathe. (Fig. 4.) This tool represents the most recent model of a high-grade hollow spindle lathe, and is specially adapted for the following purposes: The turning of steel stanchions with end flanges, the turning of launch and winch crankshafts, piston rods where forged solid with cross-head, connecting rods with open-type crank ends and Y-shaped cross-head ends. Forged work of this kind is generally very rough, and this type of lathe will be found to remove the maximum quantity of material with general handiness in working.

The quick changing of direction of feeds is a special feature of this machine. The fast headstock is powerfully geared; the large gear wheel being 24 inches diameter, as is also the largest cone. The spindle bearings are also of very ample proportions, being 5½ inches diameter by 7¼ inches and 5½ inches long, respectively. The lathe will cut right and left-hand threads. All gears and racks are machine-cut from the solid, and are of steel throughout except headstock gears, which are of cast iron, and the worm wheels, which are of phosphor bronze. The feed shaft is positively driven by six speed, quick-change gears, operated (without stopping the lathe) by a handle in front of the fast headstock. This gives ten to forty cuts per inch.

With a 12-foot bed, admitting 5 feet 6 inches between centers, this lathe weighs 4 tons.

CENTRAL THRUST HEAVY-TYPE RADIAL DRILL.

In all marine shops drilling machines play a very important part. A great many types of machines are used, but it will only be possible to describe one class, viz.: a radial. The machine selected, the Asquith radial (Fig. 5), has a very wide range of work, including drilling, boring, tapping and studding. The spindle slide is mounted upon the arm in such a way that

the thrust is taken on two slides formed in the underside of the radial arm. The construction of this arm is designed to eliminate all twisting strains and to give the greatest efficiency to the machine. The portion of the arm in which the spindle slide works is of the box-girder type, the walls of which are strongly ribbed to resist lifting stresses. The spindle works in the middle of the box-girder, thus ensuring a central thrust and a large bearing surface for the slides.

The machine shown has a radius of spindle ranging from 9 feet maximum to 2 feet 10 inches minimum, and will admit work under the spindle nose from a maximum of 8 feet down to a minimum of 3 feet 9 inches, the arm having a vertical adjustment in the column of 4 feet 3 inches. The spindle is $3\frac{1}{4}$ inches diameter in the driving part, and has a vertical adjustment by hand and self-acting mechanism of 1 foot 8 inches. It is made of high carbon steel, accurately ground and balanced. The thrust is taken by ball bearings. Double gears are fitted on the spindle slide, which can be instantly engaged or disengaged by lever at front without stopping the machine. The spindle is fitted with clutch motion, which enables it to be instantly stopped, started or reversed without using belt motion for tapping and inserting studs, changing drills, etc. Also the tap can be reversed at a higher speed.

Variable self-acting feed motion is obtained by gears which enable variations to be made instantly while the machine is running, by simply moving levers. The hand-feed has a fine adjustment. An automatic trip motion enables varying depths to be drilled, with safety stop to prevent over-traverse.

The arm is fitted with a fine radius motion, which allows of its being accurately radiused from the workman's position without having to push it over from the end. This gear can be thrown out when more rapid movement of arm is desired. The arm is fitted with hand and power motions for raising and lowering, and can be locked firmly in any position. Varying spindle speeds are obtained by means of an improved type of gear box fixed on the base of the machine.

The machine has a massive baseplate, 14 feet 9 inches long by 6 feet wide by 1 foot deep, and weighs about 18 tons.

PUNCHING, SHEARING AND BENDING MACHINE.

In view of the now prevalent use of bulb tees and angles in ship construction special punching and shearing machinery must be provided for these sections. The machine illustrated by Fig. 6, embodying several of Messrs. Scriven & Company's patents, is designed to perform quite a number of operations, which may be briefly described as follows:

The patent section shears seen in the center of the machine will cut any section of zee, channel, tee or angle from 6 inches to 15 inches wide, either right or left hand, with square or bevel ends and without changing a knife or distorting the section. The bar is supported by knives on four adjustable horizontal slides, and the shearing is effected at one stroke by a knife attached to a vertical slide fitted with independent stop motion.

At one end of the machine is a combined beam bender and bulb shears, where beams, etc., up to 15 inches deep can be cambered or straightened by a reciprocating ram and two adjusting screws. Between the screws is placed the horizontal bulb shears, with independent stop motion, for cutting off one side of a bulb to prepare a beam for receiving knees, etc., or for notching the leg of the zee, channel, tee or angle-bar.

At the other end of the machine is a horizontal twin punch, having two slides, each with independent stop motion, so that two sizes of holes can be punched in a beam or bar at one handling. The die holder is of special design, to enable holes to be punched in the webs or flanges of channels, etc. A vertical punch, on the cam and lever principle, can be placed at this end instead of the horizontal punch when desired.

VERTICAL ANGLE AND TEE-IRON BENDING MACHINE.

Fig. 7 illustrates one of the latest types of this class of machine that has only recently been put into service in a leading marine shop on the Tyne. This machine will bend angles, tees and flat bars in rings suitable for furnace rings or other purposes. It consists of a heavy cast iron table or bench, above which project four rollers, and by means of which the rings to be formed have the flanges resting on the top of the bench. Each of the rollers is made in two pieces, and so designed that the top part may be raised or lowered, thus forming suitable grooves to suit the varying thickness of sections being handled. The two center rollers are the gripping and driving rollers, being geared together by specially designed spur pinions, allowing for the necessary adjustments of centers for various thicknesses. The front roller is driven through spur and bevel gearing from a first-motion shaft, which in the machine illustrated is connected through machine-cut gearing from the motor spindle. The two side rollers are the bending rollers, and are carried in heavy slide blocks, which are traversed in suitable recesses in the bench by means of mild steel screws and a spur gear by a hand-wheel at the back of the machine, thus bending the material into circles round the front driving roller. The back center roller is adjusted to grip the bars by a hand-wheel at the back of the machine. Suitable carrying brackets and rollers are provided at the sides of the machine to support the rings while being bent.

When it is desired to bend tees into rings, having the center flange lying in the same plane as the ring, it is only necessary to remove a plate fitted to the top of the table, and which remains in position while the angles are being bent.

HYDRAULIC FORGING PRESS.

In the production of heavy forgings the hydraulic forging press has largely supplanted the steam hammer, since not only is the work produced far superior but it is effected at less

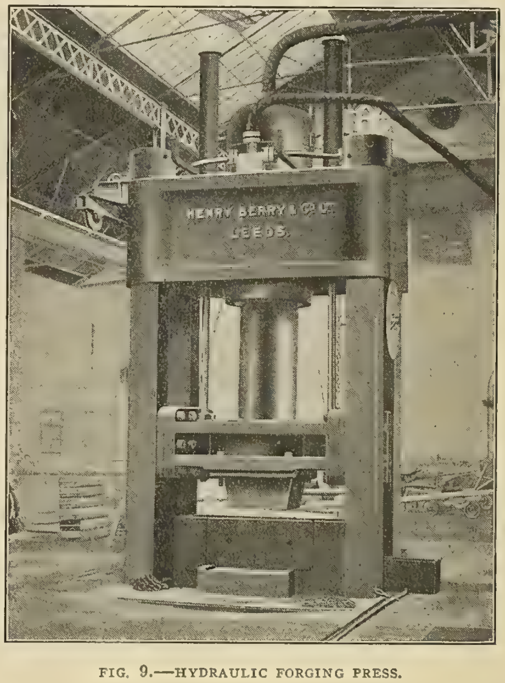


FIG. 9.—HYDRAULIC FORGING PRESS.

cost. The steam hammer also requires a skilled operator to manipulate it, whereas this press can be operated by unskilled labor.

In Fig. 9 is seen a very fine example of a heavy forging press on Berry's system. The advantage of this system consists in working the press from a low-pressure accumulator

supply, which is also available for working the lifting cylinders of the forging cranes, auxiliary appliances, etc. This low pressure is utilized in bringing the ram down to the forging, when it is then automatically intensified or increased to the maximum pressure.

COLD-SAWING MACHINE.

It will be readily understood that in all shipyards a great deal of material must be cut to dead lengths. For this purpose a cold-sawing machine is used. A standard type of this machine, possessing a number of improvements, for dealing with heavy work up to 10½ inches deep, the saw having a travel of 42 inches, is shown in Fig. 8. The work to be treated is stationary, while the rotating saw traverses through the work with a self-acting motion, and by merely moving a hand lever the saw is rapidly withdrawn ready for another cut. Automatic stops prevent overrunning in either direction. The tables are provided with tee slots, the main table being 7 feet by 2 feet 6 inches, and the side table 4 feet by 2 feet 6 inches.

The saw is 36 inches diameter, and is made of special quality hardened steel mounted on an improved flange. The saw spindle is of hard steel revolving in long, parallel bearings of phosphor bronze, which are adjustable for wear, and is driven by a phosphor bronze wheel and hardened steel worm running in a continuous oil bath.

The self-acting feed motion is variable up to 2 inches traverse per minute, and is arranged to adjust itself automatically to the section being cut, a small section being cut through rapidly and a large section correspondingly slower without any attention by the attendant.

The soapy water used as a lubricant is carried in a trough, in which the saw revolves.

PORTABLE PNEUMATIC TOOLS.

During the last ten years or so an entirely new class of labor-saving device has entered into ship construction, viz.: portable pneumatic tools. The author of this article was closely associated with the first plant installed at His Majesty's Dockyards, and can testify to the great amount of time saved in the alterations carried out on H. M. S. *Revenge* just prior to the naval demonstration at Spithead at the time of the Coronation. Since then their application to ship construction has been very rapid, and to-day no dockyard, or, indeed, private yard of any standing, can afford to be without them.

The principal tools used are riveters, drills and hammers, with a considerable variety of each type, but anything like an adequate description of their construction and application would unduly lengthen this article. It may be said, however, that they have proved themselves to be real labor-savers, and show an immense saving over hand work. Prior to their introduction work that could not be taken to a machine had to be done by hand. To-day the portable pneumatic tool is taken to the work, and not only does work previously done by hand (ratchet-brace, hand riveting, hand chipping and so forth), but it is found that in many cases it is more economical to carry the work out "in situ" by means of the pneumatic drill instead of pulling it under a fixed drilling machine. This is specially the case where several plates, etc., have to be riveted together. An immense amount of data is now at the disposal of those seeking it in regard to the saving effected over hand labor, but it may be interesting to note that as far back as 1900, in a paper read before the Institution of Mechanical Engineers, London, by the writer of this article, a table of actual results showed the great saving effected. A brief extract is given below.

Since that date the tools have been considerably improved and the men have become more skillful in their use.

When comparing the cost of pneumatic tools and hand labor it is necessary to take into consideration two points:

(1) That with the same-sized shop and practically the same standing charges a great deal more work can be turned out in the same time.

(2) That with hand labor, especially in riveting, calking and plate drilling, work can only proceed at a comparatively slow rate, however many men may be employed and however closely they work.

The cost of producing compressed air and the upkeep of the machines has also, of course, to be considered. But actual experience has shown that so long as the machines are kept in proper working order and are properly treated the saving over hand labor is very considerable.

Space does not permit of more than this brief reference to what is a very important class of machines. Fig. 10 shows an individual machine, viz.: a deck riveter, specially designed for riveting ships' decks and for bridge work. On the little carriage is mounted a Boyer riveting hammer, the weight of the holder and frame assisting the workman in keeping the riveter up to its work.

There has been a good deal of discussion and some difference of opinion expressed as to the relative values of hand and

Type of Tool.	Nature of Work Done and Time Taken.	Remarks.	Authority.
Hammer.	Calking.	In a general way, calking tools will do as much work as five or six men with ordinary tools, and the work is better done.	Alex. Stephen & Sons, Glasgow.
Hammer.	Calking.	Sixty percent cheaper than hand calking and quite as efficient. The plates are punished less, and on this account pneumatic calking is particularly useful for light plate work, such as tenders and tanks.	Mr. James Holden, Great Eastern Railway Works, Stratford.
Hammer.	For cutting off thin steel plates they have proved very satisfactory, and the work is done in one-quarter of the time taken for punching and shearing.		Ditto.
Drill.	Drilling boilers.	Very ingenious and useful tool. Can be used anywhere, even through a boiler manhole. Does its work quite as quickly as any radial or other drilling machine, being much quicker than if done by hand.	Clayton, Sons & Co., Hunslet, Leeds.
Drill.	As used for drilling work in place a ⅞-inch diameter hole can be drilled through ½-inch plate in 22 seconds.	This compares by 4 minutes with a flexible shaft, and 10 minutes with a ratchet brace.	Mr. James Holden, Great Eastern Railway Works, Stratford.

pneumatic riveting. The fact remains, however, that a pneumatically-closed rivet requires to be longer, thus showing that the hole is better filled when a pneumatic riveter is used than when a rivet is hand-driven. Not only this, but the work is completed when the rivet is at its proper heat.

In concluding this article the writer is conscious of having omitted reference to a great many important machines, but the space permitted did not allow of further details. A few words as to the future of shipbuilding may not be out of place here, since a great change in ship construction must necessarily

FIG. 10.—PNEUMATIC DECK RIVETER.

affect the machine tools employed. In view of the great developments made in internal combustion engines, it is not unlikely that they will in the near future enter largely into the propulsion of ships. This in itself will effect considerable changes in the marine shop. About 100 years ago all ships were built of timber, what will they be built of 100 years hence? It is generally acknowledged that with our present form of motive power, section of hull and method of construction, we have nearly reached the limit of speed possible under these conditions. It is safe, however, to prophesy that this is not the limit at which we shall travel on the sea in the future. Consequently, we must either find a motor which shall be lighter in relation to its power or discover a new metal, or alter our hulls both in design and structure. Probably there will be changes in each of these directions, and this will doubtless entail alteration in the design of the machine tools employed. It is obvious, therefore, that for the greatest efficiency shipyards and marine engine shops must be equipped with the latest machines, and they must be maintained in the highest state of efficiency.

THE SWEDISH TRAIN FERRY DROTTNING VICTORIA.

BY F. C. COLEMAN.

The *Drottning Victoria,* one of the four train ferries built for the new joint service, which was commenced early in July by the German and Swedish Governments for operation over the 65 miles of open Baltic Sea between Sassnitz and Trelleborg, represents one of the most interesting types of steamship which has been constructed during recent months. Not only is the *Drottning Victoria* a train ferry, but she has passenger accommodation scarcely inferior to that of the best transatlantic steamships, and ranks as the most representative example of a railway car ferry which has yet been built. She is 370 feet in length over all, 53 feet 6 inches in width over all, and has a draft, loaded, of 16 feet 6 inches. The dead-weight capacity is 600 tons, and the displacement 4,270 tons. The design was by William Hök, of Stockholm, and by the provision of deep bilge keels any rolling tendencies have been considerably minimized.

The *Drottning Victoria* has four decks, and the trains are shipped on a special track 'tween decks on two parallel lines laid to the standard Swedish and German State Railways' gage of 1.435 metres. The total effective length of the two tracks is 590 feet, and they will accommodate about ten heavy bogie corridor sleeping carriages. On the car deck the vehicles are secured by screws attached to gun-metal shackle plates, and during heavy seas there is provision for a further screw attachment from the top of the cars to the fore and aft girders of the main structure of the vessel.

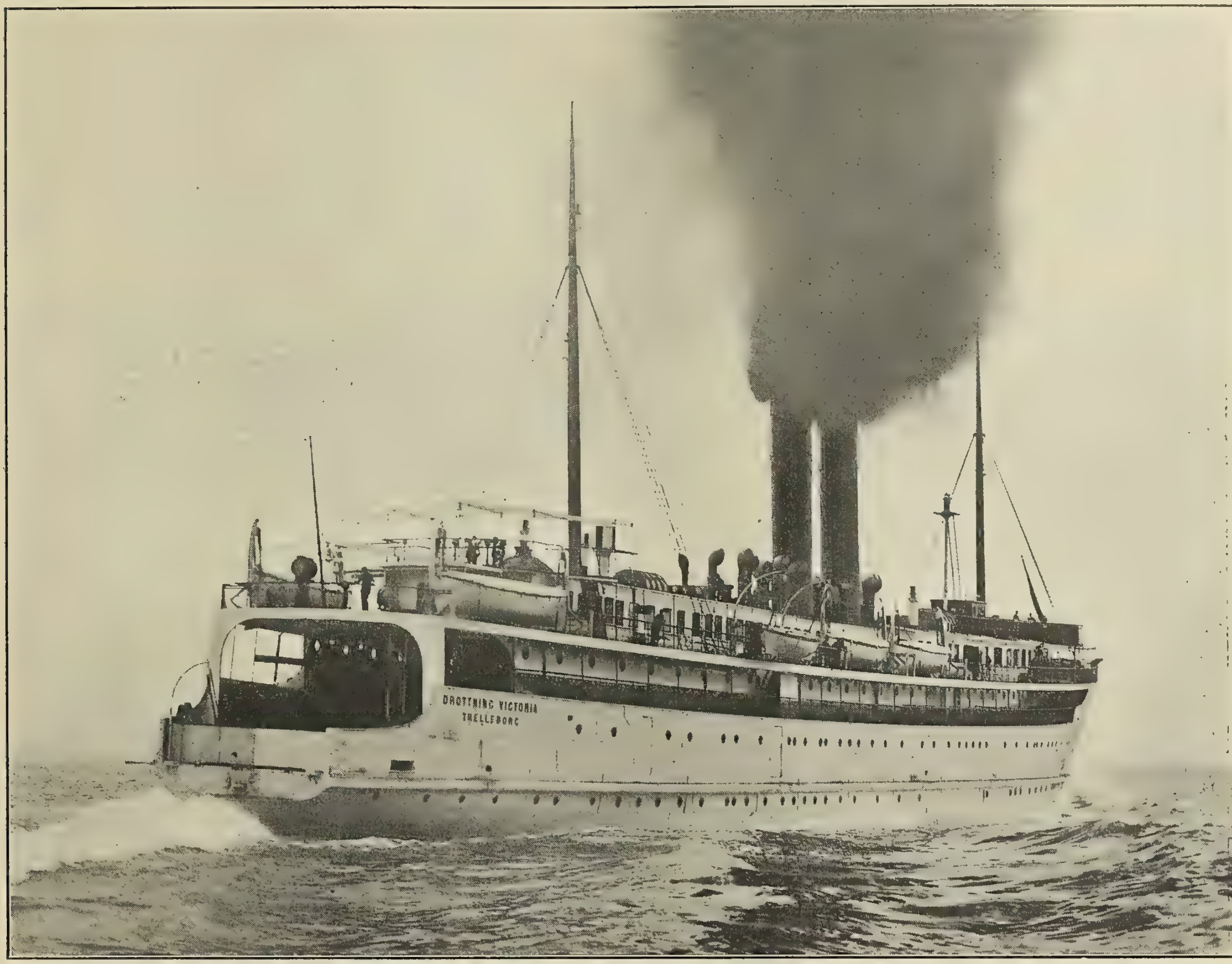
The main machinery, built at the Neptune Works of Swan, Hunter & Wigham Richardson, Ltd., consists of twin-screw triple-expansion engines, with four boilers 16 feet 4 inches diameter and 12 feet long working under Howden's forced draft. The engines are 23½ inches, 38½ inches and 63 inches diameter and 36-inch stroke, and they work at 185 pounds pressure.

During embarking and disembarking of the vehicles on the car deck, complete steadiness of the ship is secured by a system of trimming tanks, one being fitted on each side of the vessel abreast of the boilers. These tanks have each a maximum capacity of 88 tons, and there is provided in connection with them two 15-inch centrifugal pumps.

The first class sleeping accommodation is reached by means of stairways from the car deck and is situated aft of the machinery space. The third class accommodation, also reached from the car deck, is situated forward of the boiler space. On the port side is an apartment affording accommodation for twenty-two passengers. A similar apartment is situated on the starboard side of the ship, and between these is the third class dining saloon, and, at the aft end, there is a corridor leading to pantry, stewards' stores, and engineers' mess rooms. Forward of the dining and sleeping saloons are lavatories, and the space forward of these is taken up by accommodation for the stewards and crew. Aft of the first class sleeping rooms is the sleeping accommodation for the officials connected with the customs, postal and railway departments.

From the lower deck, a stairway leading from the center of the first class accommodation gives access to the promenade deck, which is divided into smoking room, lounge, ladies' room, regal apartments, and dining saloon, with accommodation for the captain and first and second officers. The smoke room is at the aft end of the promenade deck and measures 21 feet 8 inches by 24 feet 6 inches. The furnishing is in fumed oak, Old English in style. The lounge, 24 feet 8 inches by 24 feet 6 inches is in grey sycamore, finished with a high polish in a free treatment of German Renaissance. Leading from the lounge is the ladies' anteroom, which is in dark mahogany with grey panels. From the lounge, access is had to the first class entrance hall, which leads up from the car deck, and leading forward from the grand entrance is the regal room, 10 feet 10 inches by 16 feet 6 inches, which is carried out in the Adams style. The dining saloon, 39 feet 4 inches by 32 feet, is treated in Italian Renaissance, and has seating accommodation for eighty persons.

Two search lights are fitted, one at the fore end of the ship, and one the aft end, both of which are operated, and the direction of the beam of light controlled by electrical means from two control pillars, one on the forward bridge and one on the aft bridge. Fresh air, heated or cooled as may be necessary, is driven through galvanized iron trunks into the passenger accommodation by three thermo tanks, and the foul air is exhausted by a number of exhaust fans arranged in connection with exhaust ventilation trunks. There are three dynamos, each having an output of 600 amperes at 65 volts. The dynamos are each direct-coupled to a compound engine of 65 horsepower. The electrical power is controlled by a large switchboard, mounted on marble, and arranged so that the engineer has complete control of the lighting ar-



TYNE-BUILT FERRY STEAMER FOR THE BALTIC SERVICE.

rangements required at any hour of the day. In order that the engineer and captain may both know the speed of the main engines, a small electric generator is driven by chain gearing from each main engine shaft. Each generator (or transmitter) is connected by electric wires to two receivers, one in the engine room and one on the bridge, and these indicate, not only the speed of rotation, but also the direction in which the propeller is revolving.

The vessel is fitted with steering gear forward, as well as aft, to enable it to be navigated astern as well as ahead. When steaming ahead, only the aft gear is in use, but when steaming astern, both the forward and aft gears may be con-

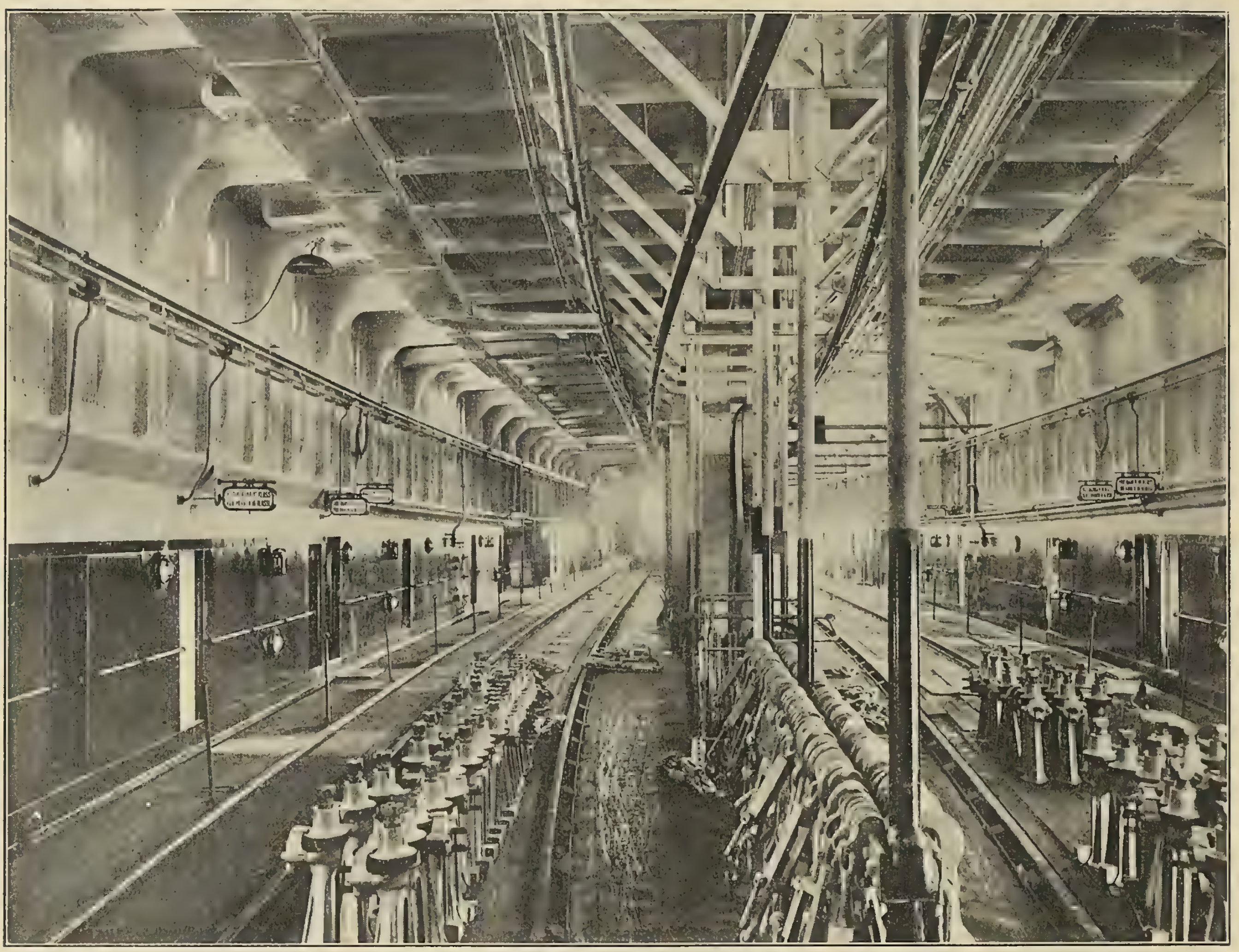
SMOKING ROOM.

THE REGAL APARTMENT.

trolled at will from the aft bridge. Each steering engine is fitted with an electric transmitter connected to indicators on the bridges, which show the angle of the rudder. Thus, on the forward bridge there is an indicator showing the angle of the aft rudder, but not of the forward rudder, while on the aft bridge there are two indicators.

There is also fitted on board the Stone-Lloyd's system of watertight doors, with electric indicating lamps in the chart room. Apparatus with two telephone receivers, also placed in chart room, is provided for the detection of submarine signals. The electric-bell system is so arranged that the train wiring is connected to that of the ship by a connection at the buffers, so that passengers on the train may be enabled to call the ship's stewards to attend them. The train accumulators are also similarly replenished from the ship's mains while the train is on board, and there is steam connection at the buffers, by which means steam is transmitted to the railway vehicle while on the car deck. The standard compass is fitted on a long pole at the height of about 28 feet above the navigating deck, so that it is out of the range of the effect produced by the cars.

Since her introduction into regular service, the *Drottning Victoria* has proved herself possessed of excellent sea-going qualities, and quite capable of regularly maintaining the contract speed of 16½ knots. The vessel was built to the order of the Swedish Government by Messrs. Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Shipyard, Walker-on-Tyne.



VIEW SHOWING THE DECK UPON WHICH THE RAILWAY TRAINS ARE CARRIED.

Turbine Generating Sets in the Navy.

The U. S. S. *Connecticut,* flagship of the battleship fleet, has recently had installed in her forward dynamo room four 100-kilowatt turbine generators, to replace high-speed engine-driven sets. These are shown in the illustration, assembled at the Hartford works of the turbine builders—the Terry Steam Turbine Company.

The turbines are of the two-stage type, designed to operate with 200 pounds initial steam pressure and 25 inches vacuum, at a speed of 1,700 revolutions per minute. Steam enters through the throttle valve into the strainer; thence through the emergency valve, which is kept open against a spring by trigger, and then passes through the governor valve controlled by the main governor.

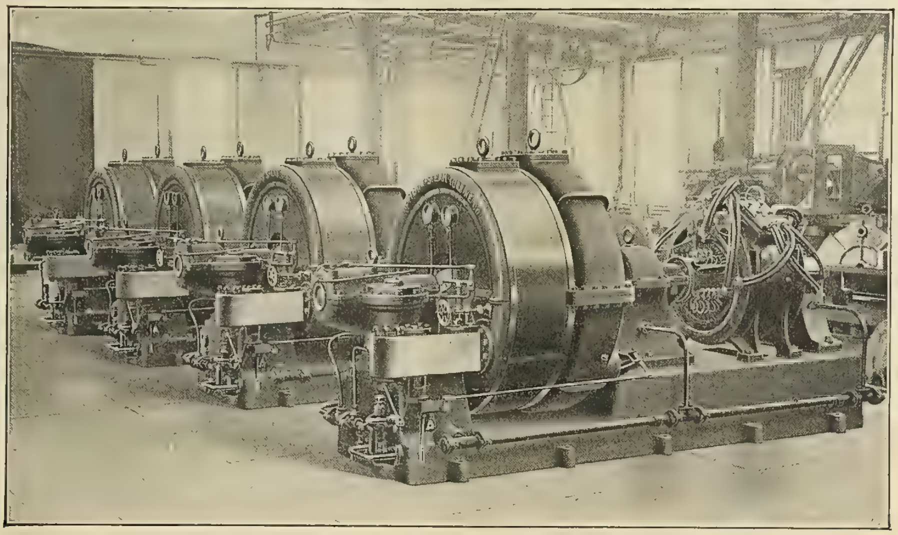
The emergency valve is tripped either by the emergency over-speed governor on the vertical worm shaft, or by the relief valve on the low-pressure stage. This valve is set to blow off at about 15 pounds pressure, and in blowing it operates the trip. A fly ball type of governor is used direct-connected to the turbine shaft operating balanced mitre throttle valve.

Steam passing through the controlling valve enters the first set of high-pressure steam jets, and thence to the wheel and the multiple velocity stages characteristic of this turbine. After doing its work in the high-pressure stage, the steam is again expanded through similarly arranged nozzles and reversing chambers in the low-pressure stage, and

thence through the exhaust to the condenser. Full load can be obtained when exhausting non-condensing, by opening an additional valve in the high-pressure stage.

The turbine casings are bolted to and supported by the main bearing pedestals, no feet being fitted on the casing proper. In this way it is free to expand; the forward pedestal being provided with a sliding foot.

Positive oil circulation is maintained to all bearings by a centrifugal oil pump at the bottom of the vertical worm shaft. The oil is drawn from the reservoir in the base of the turbine under the forward pedestal, and the reservoir is provided with coil pipe for water cooling. The oil is drained back from the bearings through filters into the oil reservoir.



TURBINE GENERATING SETS FOR THE BATTLESHIP CONNECTICUT.

A flexible shaft coupling connects the turbines to generators, which are furnished by the Diehl Manufacturing Company. The generators are 100-kilowatt, 125-volt, direct-current, compound-wound machines, fitted with inter commutating pole pieces. The double commutators are of special design, adapted for high velocities, and are mounted on a spider, which, in turn, is substantially keyed to the armature shaft. The brush area is proportioned for low-current density. These sets are built to conform to the Bureau of Equipment Specifications.

The increasing extent to which electricity is being used for lighting and power on board our battleships is shown by comparison of the *Connecticut's* dynamo equipment with that of the *Florida* or *Arkansas* now building. The *Connecticut* has eight 100-kilowatt units, while the new ships are each to be fitted with four 300-kilowatt sets of this same type.

Clyde Turbine Steamer Atalanta.

BY ALLAN M'PHERSON.

The turbine steamer *Atalanta,* built by Messrs. John Brown & Co., of Clydebank, and owned by the Glasgow & South Western Railway Company, is typical of the splendidly equipped day excursion steamers on the Firth of Clyde.

Her principal dimensions are as follows:

Length between perpendiculars	227 feet 0 inches
Breadth molded	27 feet 0 inches
Depth	10 feet 6 inches
Draft	5 feet 6 inches
Displacement	520 tons
Block coefficient	0.54
Indicated horsepower	2,500
Speed	18 knots
Tonnage, gross	400 tons

She is built of mild steel to Board of Trade requirements.

The machinery of the vessel is of historic interest, because she is fitted with the complete turbine set, which Messrs. Brown specially constructed for the extensive series of experiments, to determine many unsolved problems associated with the design of the turbines for the *Lusitania.* On the *Atalanta* the three-shaft system has been adopted, with one high-pressure turbine on the center shaft and one low-pressure turbine on each side shaft. The astern turbines are also on the side shafts inside the low-pressure cylinders.

There are two condensers placed in the wings of the ship, and each is connected to one of the two low-pressure turbines by eduction pipes of extra large size, an important necessary provision in view of the advantages of high vacuum with turbines. Water is circulated through the condensers by two centrifugal pumps.

Steam is supplied by two cylindrical boilers of the navy type, which are designed for a working pressure of 150 pounds per square inch.

On each propeller shaft there is one three-bladed propeller of bronze.

On trial trip the *Atalanta* maintained a mean speed of 18.1 knots on the double run between the Cloch and Cumbrae light houses.

The ship has four decks—lower, main, promenade and shade. The promenade deck extends from stem to near the stern and the full width of the ship. On the promenade deck forward is the chart house and entrance to the second class saloon, with the flying bridge above it. On the same deck aft, are the purser's office and main entrance to the first class saloon, with the shade deck overhead. There are two lifeboats on davits at the stern. The deck seats are of the garden pattern, with buoyancy tanks for life-saving. The main deck extends the full length of the ship and is plated all fore and aft, with the exception of a short portion of the stern in way of capstan and steering gear. On the main deck forward is the second class saloon, which forms a shelter in wet weather, and on the main deck aft is the first class saloon, which is framed in light oak. The windows are square and very large, giving a clear outlook. Adjacent to this saloon there is a tea room and a smoke room. The first class dining-saloon is on lower deck aft, and the second class on

lower deck forward. The ship is provided with steam-steering gear controlled from the flying bridge. There is a steam windlass and capstan forward, and a steam capstan aft. The vessel is fitted with electric lamps throughout.

THE INFLUENCE OF THE DEPTH OF WATER ON THE RESISTANCE AND SPEED OF HIGH-SPEED TORPEDO CRAFT.

The total resistance of a ship may be divided up into

1. Skin friction resistance.
2. Eddy-making resistance.
3. Wave-making resistance.

(2) and (3) are sometimes taken together and called the residuary resistance, as both follow Froude's law of comparison in deducing the resistance of a ship from its model. At high speeds the wave-making resistance is relatively the most important, and forms the greatest part of the total resistance. It is the alteration of the wave-making resistance, which is the most remarkable phenomenon when a ship travels into shallow water.

The nature of the wave formation depends on the variations of pressure at the bow and stern of a vessel in motion through water. These variations of pressure are affected by the

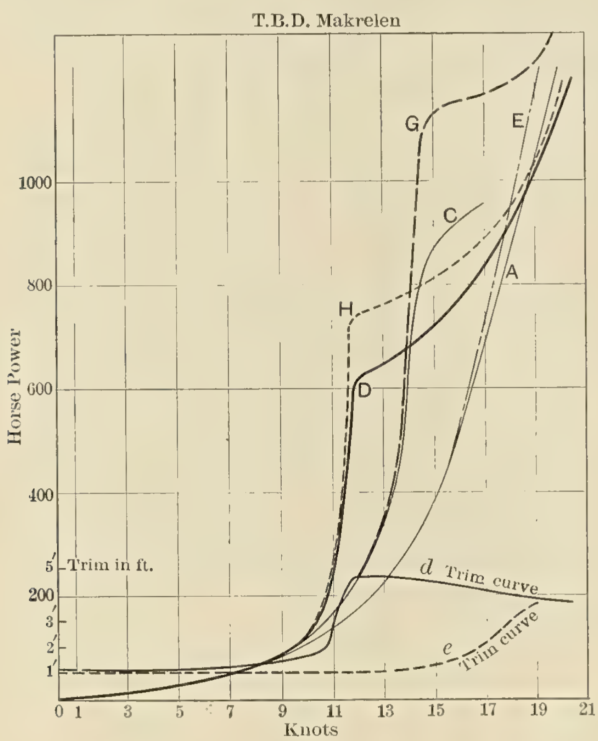


FIG. 1.

boundaries of the water in which the vessel moves. Proximity of the bottom would, therefore, tend to alter the deep-water wave formation, and, consequently, the deep-water wave-making resistance. On the other hand, the effect of the bottom would be to produce an additional frictional "drag" on the ship and so tend to increase the skin friction. Alteration of a vessel's deep-water resistance is, therefore, to be anticipated when she enters shallow water.

Scott Russell, as long ago as 1835, observed this alteration of resistance in the case of a barge being towed through a canal. He found that as the speed increased so did the resistance up to a certain point. After that point was reached the resistance dropped. He made careful measurements of the tow-rope pull at different speeds, and found the speed at which the resistance began to drop corresponded with that of the wave of translation for the depth of water in the canal. The curve of resistance on speed was of the nature indicated in the figure, and the speed at which the resistance began to decrease was approximately given by $V = \sqrt{g\ h}$,

where $g =$ acceleration due to gravity.
$h =$ depth of water in canal in feet.
$V =$ speed of wave of translation in feet per second.

Scott Russell noticed particularly that up to the speed of translation oscillating wave motions were set up and also a great disturbance in the wake left by the barge. At approxi-

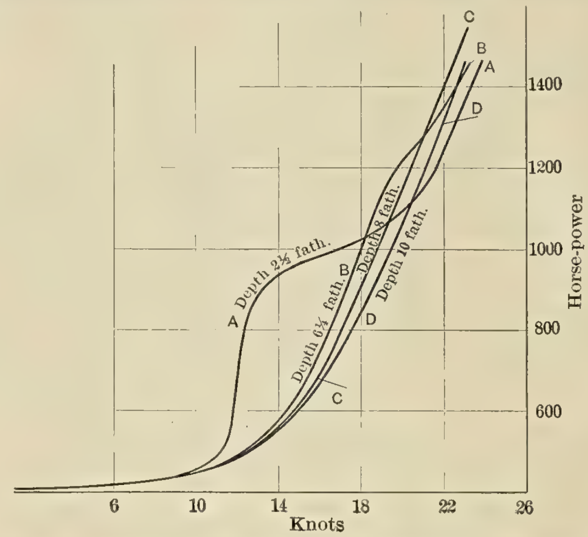


FIG. 2.—TORPEDO BOAT SÖBJÖRNEN. DISPLACEMENT 132 TONS.

mately the speed of translation the disturbance disappeared, and the vessel appeared to be traveling on a single wave.

Sir William White, in his *Manual of Naval Architecture,* gives details of the performance of actual ships in shallow water. For instance, he mentions that H. M. S. *Edgar,* in the Stokes Bay measured mile, required 13,260 indicated horsepower to get 20½ knots in 12 fathoms. In water 30 fathoms deep she attained a speed of 21 knots with 12,550 indicated horsepower.

Messrs. Yarrow experienced some difficulty in getting the contract speed of 25½ knots on the Maplins mile at the mouth of the Thames for the river-class destroyers built by them for the British Admiralty. This was rightly ascribed to the effect of the depth of water in which the trials took place. The firm carried out a series of progressive trials, and model experiments were made to find out what the effect of shallow water was on their boats. These results were laid before the Institution of Naval Architects in 1905. Other experiments have been made by Herr Popper and Messrs. Denny.

Capt. Rasmusser, of the Danish navy, carried out some extremely interesting research work on the resistance of torpedo craft in shallow water (see Trans I. N. A., 1899). Figs. 1 and 2 are curves of horsepower on speed for two torpedo boats. In addition, Fig. 1 shows the effect of alteration of displacement and the variation in trim of the torpedo boat *Makrelen,* when running in different depths of water at varying speeds. In Fig. 1 it will be noted in the shallow depths (given by curves *D* and *H, C* and *G*) the speeds of waves of translation are reached. Thus the speed of a wave of translation in a depth of 2 fathoms is nearly 11 knots, and that in a depth of 3¼ fathoms is about 14 knots. These speeds approximately coincide with the critical speeds at which the points of inflexion occur (and it is seen that the latter correspond to the same speed for both displacements). In other

words, the critical speed is independent of displacement. However, this cannot be taken as established on the information available, since only the horsepower curves at two displacements of the same vessel are given. The trim curves *d* and *e*, corresponding respectively to the shallow depth of curve *D* and the full depth of curve *E*, show that in shallow water at the critical speed we get an abnormal trim by the stern, but after passing that speed the trim decreases and approaches that in deep water. Comparing curves *A* and *D* of Fig. 1, it will be observed that at a speed of about 18¾ knots the curves cross. At speeds below 18¾ knots the horsepower for the same speed is greater in shallow than in deep water; above that speed the reverse holds, and in shallow water at speeds above 18¾ knots we get a greater speed than would be obtained in deep water for the same expenditure of horsepower. Fig. 2 establishes the same thing for another torpedo boat run at high speeds in depths of water varying from 2½ to 10 fathoms. These curves, Figs. 1 and 2, show also that

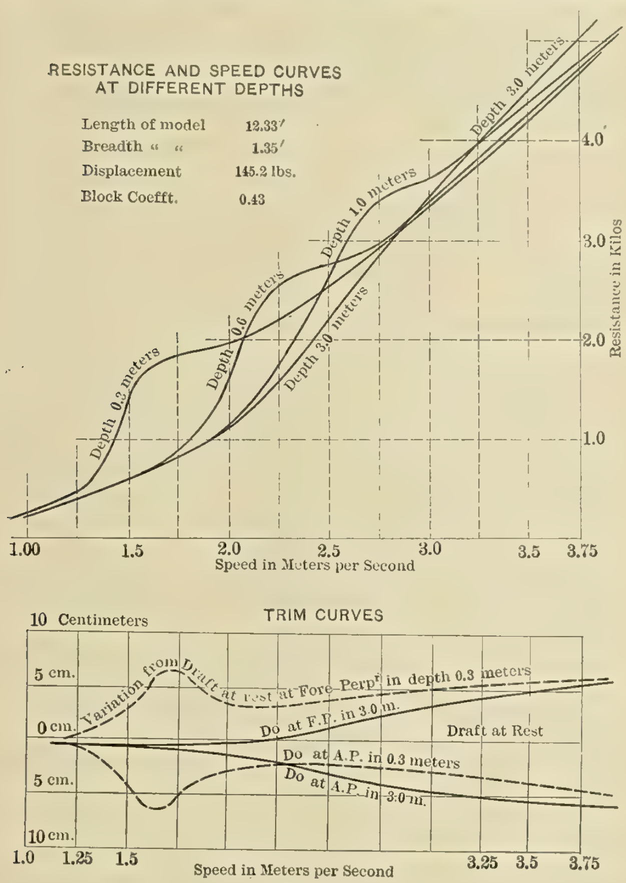


FIG. 3.

the points of inflexion in the horsepower curves become more marked and occur at lower speeds as the water shallows.

Major Rota (now lieutenant-colonel), of the Royal Italian navy, made experiments on models in the Italian tank at Spezia, one of these models representing a torpedo boat. The results of these experiments are of the greatest importance, and the experiments themselves may properly be termed classical. Figs. 3 and 4 exhibit the results obtained with the torpedo boat model run at a constant displacement. This model was 12.33 feet long, 1.35 feet broad, with a displacement of 145.2 pounds. The block coefficient was 0.43. Rota's curves of resistance on speed for different depths of water (Fig. 3) show just the same characteristics as the curves of Rasmussen and other experimenters. The most important of these characteristics may be summarized as follows:

1. The points of inflexion in the horsepower on resistance curves become more marked and occur earlier the shallower the water.

2. At high speeds for the same expenditure of horsepower it is possible to get a greater speed in shallow than in deep water.

3. All the curves show that the point of inflexion occurs approximately at a speed given by $V^2 = g\ h$ (V being expressed in feet per second and h in feet). If V is expressed in knots and h in fathoms, the formula for the critical speed becomes $V^2 = 60\ h$, h being the depth of water in fathoms.

Both Rota's and Rasmussen's results show the marked alteration in trim at and near the critical speed. Observation has shown that as a vessel traveling at a high speed enters shallowing water the trim by the stern begins to increase, and continues to increase until the speed of the wave of translation is reached corresponding to the depth of water. At this speed the vessel seems to be traveling on the back slope of a steep, solitary wave, and the ordinary oscillating transverse wave system seems to have disappeared.

Rota assigned the alteration in resistance in shallow water to the abnormal trim by the stern, but the phenomenon would appear to admit of a fuller explanation. The principal feature in wave-making resistance is that at a certain speed in relation to the length of the vessel there is a great and usually sudden increase of resistance. This is clearly shown by the humps in the curves of resistance or horsepower on speed. The center

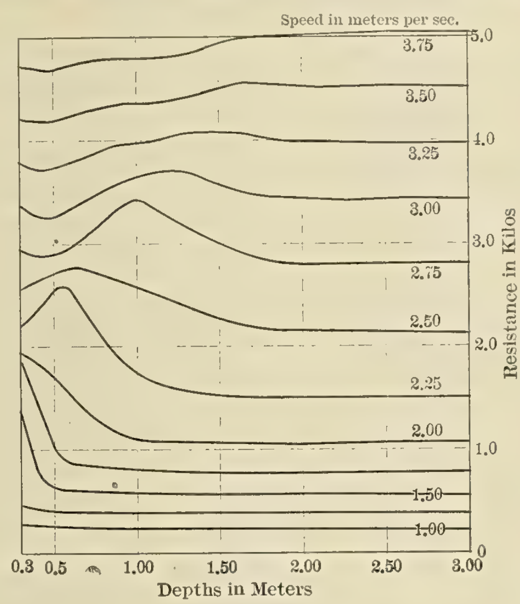


FIG. 4.

of the hump approximately coincides with the speed at which the length of the wave* corresponding to that speed agrees with the distance between the bow and stern primary waves which the hull tends to form. The hump in the curve will hence occur when a certain conjunction of bow and stern-wave lengths is effected.

Now, the wave length* corresponding to the speed of the vessel is affected by the depth of water when that depth is below a certain limit, so that as the depth of water decreases so does the speed of the wave, and the hump is pushed further and further down the curve until we reach a state of things when the ordinary wave system cannot be formed. The stern transverse system has disappeared and the bow system has become degraded into a single wave of translation. This wave

* (In oscillating waves, if V be speed of wave, and L be length of the same, then, in deep water $V^2 = \frac{gL}{2\pi}$, and in shallow water $V^2 = K \frac{gL}{2\pi}$ where K is less than unity and depends on depth of water when that depth is below a certain limit. Hence it is seen that a shallow-water wave must travel at a less velocity than a deep-water wave of the same length.)

when once formed absorbs no further energy from the vessel. The only large resistances are then those due to skin friction and eddies.

It is thus seen that after the wave of translation is once set up the total resistance decreases, and it is then clear why a vessel at high speeds in shallow water below a certain depth is able to obtain a greater speed than in deep water for the same expenditure of horsepower.

It is very interesting to apply Rota's curves (Fig. 4) to actual vessels using Froude's law of comparison. This law is only applicable to the residuary resistance, and, strictly speaking, in applying model results to actual vessels regard should be had to the skin friction correction. The law of comparison applied to the total resistance of a model will give a rather larger estimate for the total resistance of the ship. However, at high speeds, and before the oscillating wave system becomes merged into a wave of translation, a first approximation to the results to be expected for actual ships which are substantially similar in form to Rota's model may be obtained by using Froude's law. This states:

"If the linear dimensions of a ship be one time that of its model and the resistances of the latter are r_1, r_2, r_3—at speeds V_1, V_2, V_3—the resistances of the ship will be $r_1\ l^3$, $r_2\ l^3$, $r_3\ l^3$; at corresponding speeds $V_1 \sqrt{l}$, $V_2 \sqrt{l}$, $V_3 \sqrt{l}$." * * *

Applying this law to an 860-ton destroyer the dimension

$$l = \sqrt[3]{\frac{\text{displacement of ship}}{\text{displacement of model}}} = 23.7.$$

Now, depth will vary as l.

Speed as $\sqrt{l}$.

Resistances as l^3.

Horsepowers as $l^{7/2}$.

Hence 8 fathoms for the destroyer corresponds to about 0.6 meters in the model; 10 fathoms for the destroyer corresponds to about 0.77 meters in the model; 38¾ fathoms for the destroyer corresponds to about 3.0 meters in the model. Hence, interpolating in the curves in Fig. 4 we can get the resistance on speed curves of the model at depths 0.6, 0.77 and 3 meters. The resistances and E. H. P's of the ship are then readily deduced by Froude's law. The table gives the estimate of the E. H. P's for an 860-ton destroyer at different depths of water:

	E. H. P. in		
Speed.	8 Fathoms.	10 Fathoms.	38¾ Fathoms.
32 knots.....	11,300	11,750	12,300
33 "	12,400	12,600	13,450
34 "	13,300	13,600	14,500
35 "	14,300	14,450	15,300
36 "	15,250	15,750	16,450

These results are plotted in Fig. 5, and show that the increase of speed for such a vessel obtained by running in shallow water of 8 fathoms is about 1.3 knots over what would be obtained in deep water of 38¾ fathoms when developing the same E. H. P.

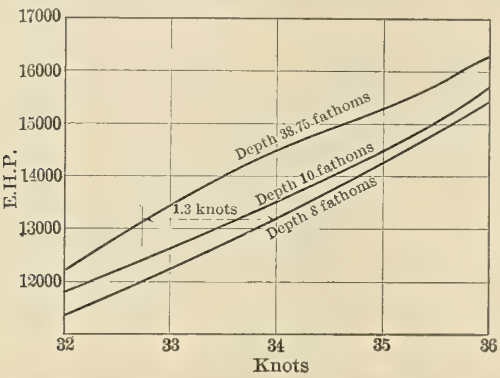


FIG. 5.—E. H. P. CURVES FOR 860-TON SHIP. (BASED ON ROTA'S CURVES.)

This result is confirmed in a striking manner by data given in a paper read by Sir Phillip Watts before the I. N. A. at the recent spring meetings on the speed trials of the torpedo boat destroyer *Cossack* at the Maplins and Skelmorlie. (See INTERNATIONAL MARINE ENGINEERING, July, 1909, page 256.) The naval list displacement of the *Cossack* is given as 885 tons, and the depth of water in which she ran was 7.4 fathoms on the Maplins and 40 fathoms at Skelmorlie. For the same shaft-horsepower to produce 34 knots on the Maplins she got about 1.4 knots less at Skelmorlie. The actual results are seen to be in very close agreement with the results obtained from Rota's curves.

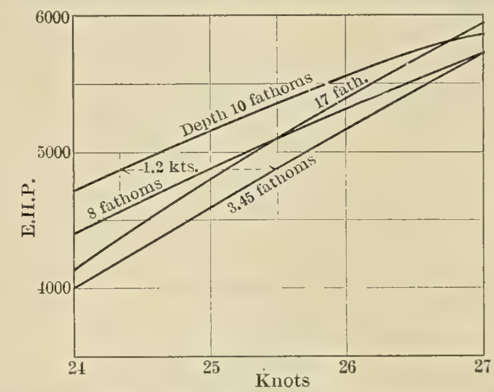


FIG. 6.—E. H. P. CURVES FOR 600-TON SHIP AT DIFFERENT DEPTHS.

As already pointed out, the E. H. P's given in the table are overestimated, but for small ranges of speed in the neighborhood of the high speeds taken, the skin friction correction would reduce these E. H. P's approximately pro rata, and, therefore, would not affect the value of the estimate for gain or loss of speed due to shallow water. Rota's curves are hence of the greatest practical value.

For a 600-ton destroyer (say of the river-class type), calculations based on Rota's curves neglecting the skin friction correction give:

	E. H. P. in			
Speed.	8 Fathoms.	10 Fathoms.	17 Fathoms.	345 Fathoms.
24 knots....	4,425	4,775	4,180	4,000
25 "	4,875	5,150	4,800	4,560
26 "	5,320	5,350	5,400	5,170
27 "	5,750	5,900	5,950	5,740

Fig. 6 shows these results plotted. Of the four depths taken it is seen that the greatest depth is the most favorable. A 600-ton destroyer, which develops 25½ knots in 34½ fathoms, would decrease her speed by about 1.2 knots in 10 fathoms, .5 knot in 8 fathoms, and .4 knot in 17 fathoms, assuming the E. H. P's were the same in each case. Fig. 7 shows the E. H. P. curves of a 750-ton destroyer at different depths of water, based on Rota's curves. Of the four depths taken, viz.: 8, 14, 17 and 37 fathoms, it will be seen that the extreme depths of 8 and 37 fathoms are the most favorable for a speed of, say, 28 knots, there being little to choose between them. Such a destroyer which obtains 28 knots in 37 or 38 fathoms would get about 1¼ knots less in water 14 fathoms deep, and about ¾ knot less in 17 fathoms. For 29 knots the shallowest depth is the most favorable.

The determination of the minimum depth of water to obtain the normal deep-water resistance is of the utmost importance in arriving at the true speed of the ship. In arriving at an estimate we can again have recourse to Rota's curves in Fig. 5.

In the case of the 860-ton ship 3.75 meters per second in the model correspond to about 35.5 knots in the ship; 3.5 meters

per second in the model correspond to about 33.2 knots in the ship; 3.25 meters per second in the model correspond to about 30.4 knots in the ship; 3.00 meters per second in the model correspond to about 28.6 knots in the ship; 2.75 meters per second in the model correspond to about 26.3 knots in the ship. Also a depth of 2.0 meters for the model corresponds to 26 fathoms for the ship; 2.5 meters for the model corresponds to

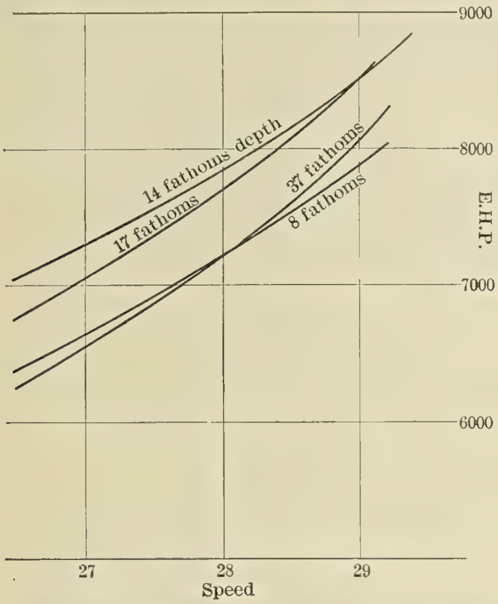


FIG. 7.—E. H. P. AND SPEED CURVES FOR 750-TON SHIP. (BASED ON ROTA'S CURVES.)

32.6 fathoms for the ship; 3.0 meters for the model corresponds to 38.75 fathoms for the ship.

Now, for speeds of from 3.0 to 3.75 meters per second an inspection of Rota's curve in Fig. 4 shows that the resistance curves are parallel to the base line. Hence for the 860-ton ship it would appear that at speeds of from 30 to 35 knots a minimum depth of about 33 fathoms is sufficient to obtain the normal deep-water resistance. For the 600-ton ship, at speeds of from 22 to 27 knots, a minimum depth of 23 fathoms would be sufficient. Similarly, for the 750-ton ship, at speeds of from 27 to 30 knots, the minimum safe depth for the normal deep-water resistance is about 27 fathoms. J. R.

TWIN-SCREW STEAMER FOR SUBMARINE MINE SERVICE.

BY HARRY L. FULLER AND V. R. MARSDEN.

The steamer *Gen. E. O. C. Ord* was launched Feb. 13, 1909, at the yards of the Pusey & Jones Company, of Wilmington, Del. The boat was designed by the Quartermaster's Department, U. S. A., Washington, D. C., and is of the following dimensions:

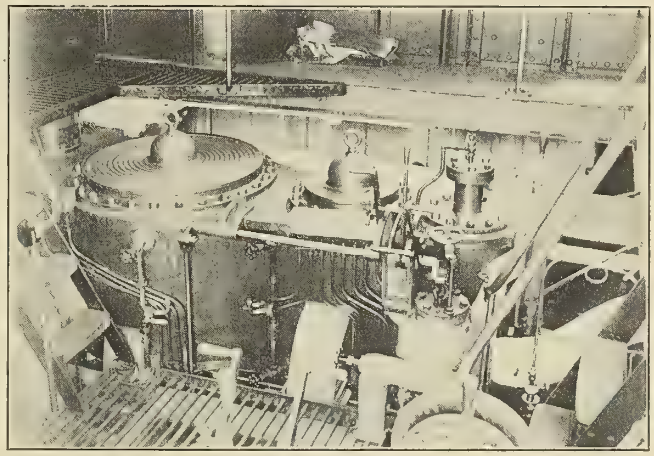
	Feet.
Length on deck	165
Length on loadline (10 feet above base)	154
Breadth of beam, molded	32
Depth, molded, amidships	17
Draft, loaded	10
Speed per hour (statute miles)	13

The hull is constructed of the best open-hearth mild steel, having a tensile strength of not less than 38,000 pounds, nor more than 68,000 pounds per square inch of section, and under the inspection and gage tests of the American Bureau of Shipping.

The steamer is divided into five compartments by watertight cross-bulkheads. A double bottom extends nearly the entire length, and is divided into compartments, which provide for the safety of the ship in event of grounding, and which can also be used to vary the trim and draft by means of water ballast. There is also one tank in the forward peak and one in the after peak, used for fresh water and trimming of the ship.

The double bottom is of the cellular type, and extends from frame No. 6 to frame No. 78. The center-line vertical keel is continuous, of 16-pound plate, 42 inches deep from frame No. 6 to frame No. 35, 36 inches deep from frame No. 55 to 34 inches deep at frame No. 78, 30 inches deep from frame No. 37 to frame No. 53. The keel is double-butt strapped with 12-pound plate, treble riveted, and secured to the flat keel plate and tank top by double-continuous angles; the bottom angles being 4 inches by 3 inches by 8.5 pounds and the top

THE GEN. E. O. C. ORD.



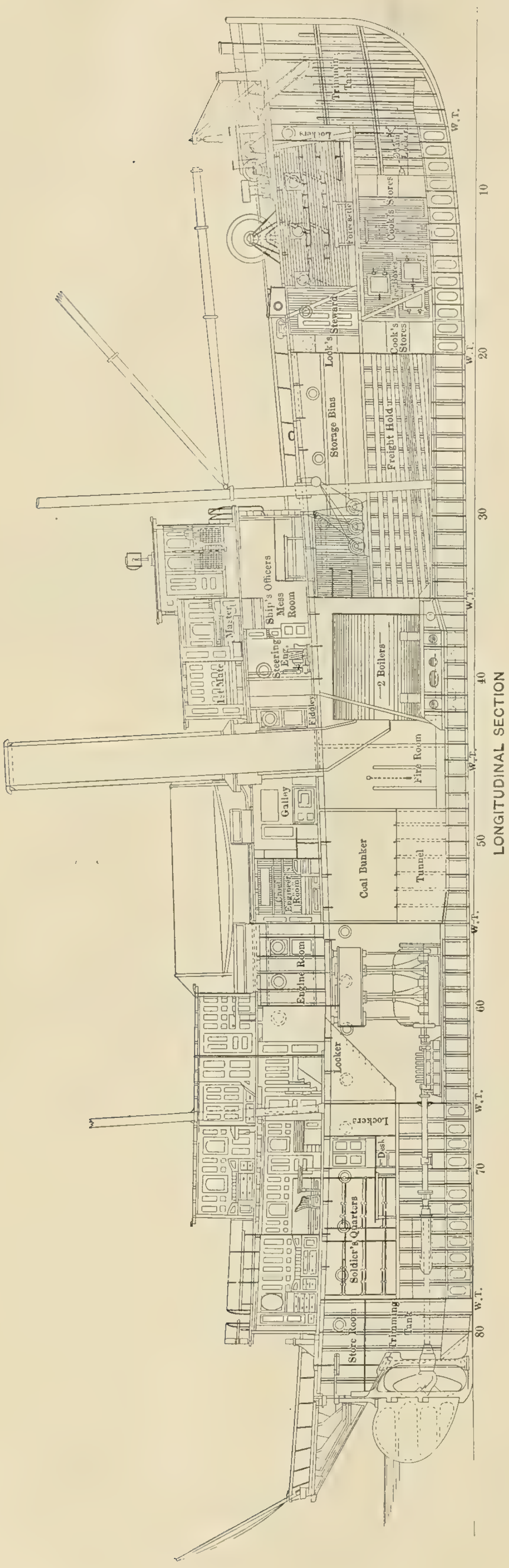
VIEW OF PORT ENGINE.

angles 3½ inches by 3 inches by 7.8 pounds. The angles connecting the vertical plate with the transverse floors are 3 inches by 2½ inches by 6.6 pounds, double.

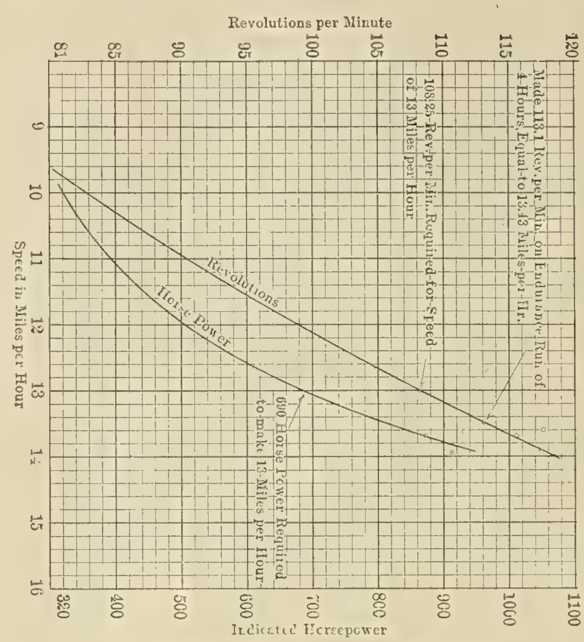
The flat keel plates are 36 inches wide by 22 pounds, and worked in lengths of not less than nine frame spaces. The butts are treble riveted, 28 pounds, and extend to the edge of the garboard strakes.

There are two longitudinal keelsons on each side of the center line, worked intercostal between alternate floors, and properly lightened with manhole openings. They are of 14-pound plate, and extend as far into the ends as practicable; all secured to the shell plating, tank tops and floors by 3 inches by 2½ inches by 6.6-pound angles. Under the engines the floors, or longitudinals, are continuous.

The tank side margin plates are of 14-pound steel, worked



INBOARD PROFILE OF GEN. E. O. C. ORD, SHOWING LOCATION OF HOLDS, MACHINERY AND LIVING QUARTERS.

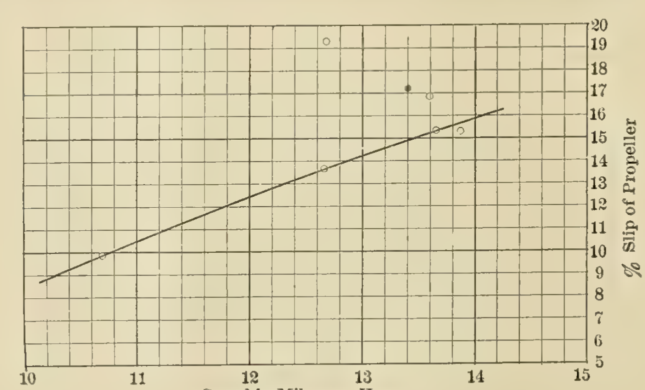


REVOLUTION AND HORSEPOWER CURVES.

continuous and flanged for connection with the tank-top plating, 3 inches by 3 inches by 7.2-pound angles, worked continuous at the lower edge. There are transverse floors on every frame, and alternate floor plates worked intercostal between longitudinals, with 3 inches by 2½ inches by 6.6-pound angles, and secured to the shell plating by 3 inches by 3 inches by 7.2-pound angles; other floors are continuous from the tank margin to the vertical keel, the continuous floors being lightened by manhole openings between longitudinals except at watertight divisions, where all construction is properly stapled, riveted and calked thoroughly watertight. All floors are of 14-pound plate with angles as above, except under the boiler saddles and engine foundation, where they are of 16-pound plate. The floors at the ends are reduced to 12-pound plate. Deep floors are provided in trimming tanks, as shown on the longitudinal section, also at the forward end of the stern tubes, all properly stiffened.

The tank-top plating is of 14-pound steel reduced to 12 pounds at the ends. The middle strakes throughout the engine and boiler spaces are of 16-pound plate, laps single riveted and butts double riveted.

The shell plating is in seven strakes, amidships on each side. Of the latter, the garboard strake *A* measures 18 pounds throughout. Strakes *B* and *D* measure 16 pounds and 17.5 pounds forward and 14 pounds aft. Strake *C* measures 16 pounds aft and amidships and 17.5 pounds forward. Strake *E* measures 16 pounds amidships and 14 pounds at the ends.



PROPELLER SLIP CURVES.

Strake *F* measures 15 pounds for three-fifths length and 13 pounds at the ends. There are two bilge keels, extending on each side of the ship from frame No. 25 to No. 59, composed of 5 inches by 3 inches by 13.6-pound tee bars riveted to the shell and riveted to 15-pound plate, 12 inches wide, with a 2½-inch hollow half-round bar riveted to the outside edge on the upper side. All strake laps are 4½ inches wide, and are joined by ¾-inch double riveting.

The main frames are 3½ inches by 3 inches by 8.5 pounds; 3½ inches by 3½ inches by 7.9 pounds at the ends extending in one piece from the margin angle, or keel, to the main deck, spaced 22 inches centers. Intermediate frames, 3½ inches by 2½ inches by 6.6 pounds in the eighteen forward frame spaces, extend in one piece from the margin angle, or keel, to the upper stringer. Reverse frames, 3 inches by 2½ inches by 6.6 pounds are located on every frame extending in one piece from the margin angle, or keel, to the upper stringer and main deck, alternately, except in the engine and coal bunker spaces, where all extend to the main deck. Belt frames, 15 inches wide, of 14-pound plate, double-face angles, 3½ inches by 2½ inches by 6.6 pounds, are on frames 25, 30, 38, 42, 48, 51, 59 and 63. The stem is a bar-iron forging, 1¾ inches by 8 inches, and the stern frame, 3½ inches by 8½ inches, of cast steel.

The main deck beams are channels, 8 inches by 3½ inches by 3½ inches by 22 pounds and 7 inches by 3½ inches by 20 pounds at the ends, spaced 44 inches centers. The berth deck beams are 5 inches by 3 inches by 11.3 pounds and 4 inches by 3 inches by 9.8 pounds at the ends, spaced 22 inches centers. The deck-house beams are 3½ inches by 2½ inches by 8.3 pounds, spaced 22 inches centers. The main deck and deck-house beams have a crown of 8 inches in 32 feet. Bulkhead angles are 3½ inches by 3½ inches by 8.5 pounds.

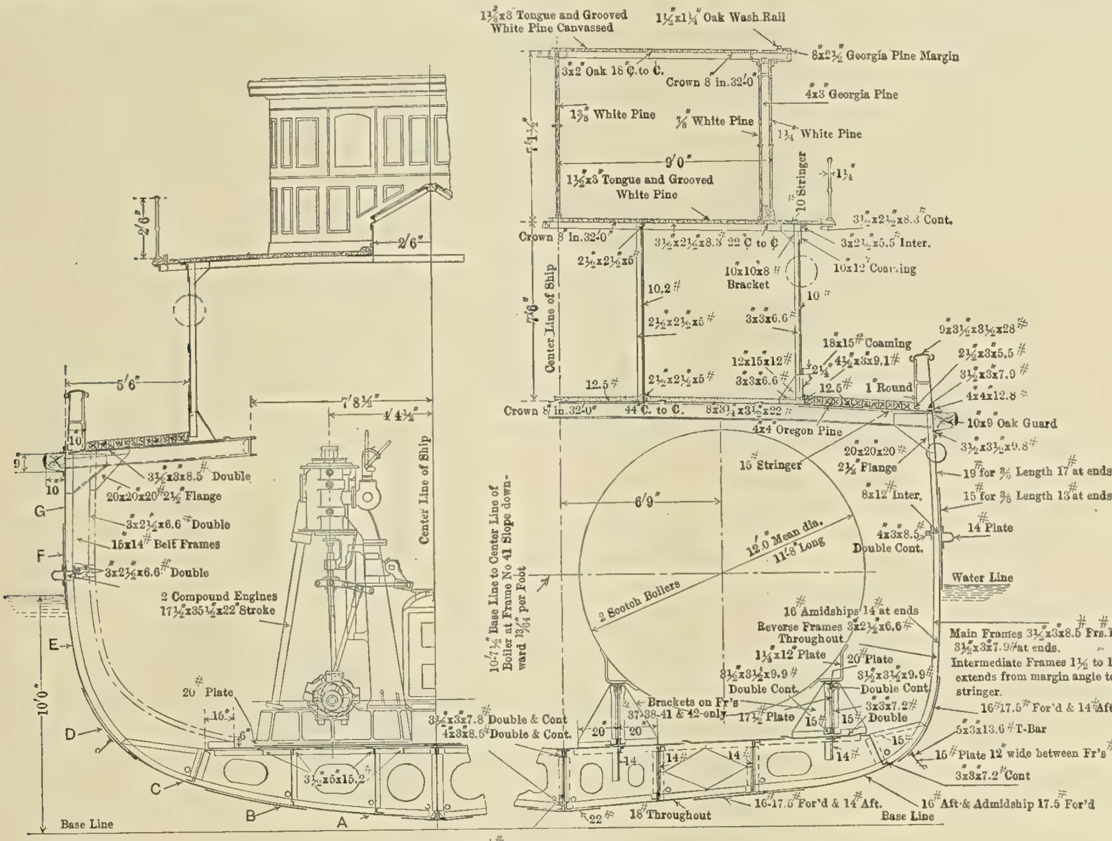
MACHINERY.

There are two main engines of the two-cylinder, vertical, direct-acting compound type, well balanced, and each capable of developing about 345 indicated horsepower at 108.25 revolutions per minute, at a steam pressure of 150 pounds per square inch. The illustration shows the port engine as installed in the ship. The sequence of cylinders, beginning forward, is high-pressure and low-pressure, with diameters, respectively, 17½ inches and 35½ inches and a common stroke of 22 inches.

The cranks are set at 90 degrees. The high-pressure cylinder has one piston valve, with a diameter of 9 inches on top and bottom. The low-pressure cylinder has a flat, double-ported slide valve. The valve stems are in all cases 2¼ inches in diameter, while the piston rods are each 3½ inches diameter. The valves are operated by Stephenson's link motion from eccentrics, and are worked by a steam reversing engine. The main engines are in a single engine room without a center-line bulkhead, the starting platform being very conveniently located between the engines, with ample space for the engine crew to work in. The cylinders are fitted with safety valves in the bottom and cover. The cylinders are supported by hollow cast iron columns on the inboard side, and high-grade machinery steel columns, 3½ inches diameter, bolted to the bed-plate on the outboard side. All stuffing-box packings of the main engines are Katzenstein's metallic packing.

The steam pipe to each engine is 5 inches diameter. The pipe carrying steam from the high-pressure to the low-pressure cylinder is 8 inches diameter, and the exhaust from each engine to the condenser is 10 inches diameter. The main engines also have a 7-inch exhaust from each engine, combining into a 10-inch pipe, leading through the side of the ship to the atmosphere, just below the main deck, with a stop valve on the skin of the ship. All steam and exhaust pipes to and from the main engine are of copper.

The shafting, which is made of the best forged steel, con-



Section at Frame No.58 Looking Aft. Section at Frame No.40 Looking For'd

MIDSHIP SECTION OF GEN. E. O. C. ORD, SHOWING SCANTLINGS.

sists of crankshafts of the built-up type, with a diameter of 7½ inches; thrust shafts, 7½ inches diameter (7¾ inches between collars), and tail shafts, 7½ inches diameter.

The two propellers, which are four-bladed, one right and one left handed, are of the solid type, 8 feet diameter by 12 feet 3 inches pitch, and have a developed area of 30.9 square feet. It may be mentioned that the propellers are provided with guards to prevent cables from fouling them.

THE BOILERS.

Two single-ended Scotch boilers of the cylindrical type, working at a pressure of 150 pounds per square inch, are located in one boiler room, and have a single funnel. The furnaces, three in each boiler, have internal and maximum diameters of 39 inches and 42 27/32 inches, and are 27/64 inch thick. The grates are 6 feet ½ inch long, the grate surface of each boiler being 58.5 square feet, while the heating surface in each boiler is 1,874.5 square feet, or a ratio of 32 to 1; making for the two boilers an aggregate grate surface of 117 square feet, and a total heating surface of 3,749 square feet. The three furnaces have a common combustion chamber, and they are of the removable type. The length of tubes between tube sheets is 8 feet 4 inches, and they are spaced 4 inches apart in each direction. Each boiler contains 232 tubes, of which thirty-two are stay tubes; all have an outside diameter of 3 inches with a thickness of No. 6 B. W. G. for the stay tubes and No. 11 B. W. G. for the ordinary tubes. The tube sheets have a thickness of ⅝ inch. The top of the combustion chamber, which is ½ inch thick, is supported by the usual bridge girders. The funnel, which has a circular section, consists of an inner stack, 57 inches diameter, and an outer stack, 67½ inches diameter with an air space of 5¼ inches.

THE AUXILIARY MACHINERY.

The two main engines have a common condenser, with a cooling surface of 1,602.73 square feet. The cooling pipes are of seamless-drawn brass, with an outside diameter of ⅝ inch. The air pump is a 10 by 18 by 18 by 14-inch independent vertical beam pump. The circulating pump is also independent, and driven by a direct-connected vertical engine, 6 by 6 engines, working on a steam pressure of 100 pounds. A table is given of the exact number and style of pumps, with the location of their suction and discharge and the sizes of their various connections.

There is a 20-kilowatt, direct-connected General Electric Company turbine generator, which furnishes current for lighting the ship and also for the winches and capstans, which include one three-drum, 15-horsepower electric winch and one double-drum, 10-horsepower electric winch of the Lidgerwood make, located near the foremast on the intermediate deck in the hold, and in connection with the derrick gear above and two vertical capstans of the Hyde windlass make; one mounted on the center line just forward of forecastle companionway, with its shaft extending through a watertight connection in the deck, with gearing connecting to a 5-horsepower motor, and one mounted on the starboard side aft in connection with towing bitts in rear of deck house. This is of the vertical turning capstan type for rapid handling of tow lines, and is driven by a 5-horsepower motor installed under the deck, and connected by work gearing. All electric connections are made complete from a switchboard in the engine room, the after capstan being connected on an inde-

PUMP SCHEDULE.

Name.	Type and Size.	Steam	Exhaust	Suction.	Discharge.
Main air.....	10–18–18 x 14″ vertical beam.	1¼″	2″	7″ condenser......	6″ overboard. 4″ filter tank.
Circulating...	6 x 6″ engine...	1½″	1¾″	8″ sea............ 8″ bilge...........	1¼″ water service. 9″ condenser.
Main feed...	9–5¼ x 12″ vertical L. S..	1″	1¼″	3″ condenser (air pump channel-way)........... 3″ filter tank...... 3″ F. W. tanks....	2½″ boilers direct. 2½″ boilers via feed. water heater. 2½″ F. W. tanks. 2½″ filter tank.
Auxiliary feed	9–5¼ x 12″ vertical L. S..	1″	1¼″	3″ condenser (air pump channel-way)........... 3″ filter tank....... 3″ F. W. tanks....	2½″ boilers direct. 2½″ boilers via feed water heater. 2½″ F. W. tanks. 2½″ filter tank.
Donkey.....	9–5¼ x 12″ vertical L. S..	1″	1¼″	3″ sea............ 3″ bilge manifold.. 2″ boilers.......... 2½″ F. W. tanks...	2½″ boilers direct. 1½″ sanitary system. 2½″ F. W. tanks.
Bilge........	9–5¼ x 12″ vertical L. S..	1″	1¼″	3″ sea............ 3″ bilge manifold..	2½″ firemain. 2½″ condenser. 2″ water service.
Fresh water..	4½–4 x 6″ vertical L. S..	½″	¾″	2″ F. W. tanks....	1½″ F. W. system.
Sanitary.....	4½–4 x 6″ vertical L. S.	½″	¾″	2″ sea............	1½″ sanitary system.
2″ injectors..	Metropolitan No. 12½ model "O"..	1½″ each		1½″ sea (each)..... 1½″ F. W. tanks each...........	1½″ auxiliary feed-line (each). 1¼″ hose connection (each).

STANDARDIZATION TRIALS

Left dock at 10.40; trial began 11.45; draft forward 10ft. 4 ins.; draft aft 10 ft. 2½ ins. mean draft for trip 10 ft. 3¼ ins.; tons of coal on board, 50; number of men on board, 35. Returned to dock at 7.10; trial ended 6.24; draft forward 10 ft. 3 ins.; draft aft 10 ft. 0 ins.; mean displacement 832 tons; tons of water on board, 81; weather, clear and warm.

Time.	No. of Card.	Revolutions Per Min.		Pressures.				Port Engine I.H.P.	Starboard Engine I.H.P.	Total I.H.P.	Rev. Per Min.	Double Strokes Per Min. of Pumps.		Water Temperature.				Air Temperature.			Remarks.
		Port.	Starboard.	Steam.	Receivers Port.	Receivers Starboard.	Vacuum.				Circulator.	Air.	Feeds.	Sea.	Discharge.	Hot Well.	Feed.	Outside.	Engine Room	Fire Room	
Down 5.44	1	110 (Mean	109.5 109.7)	110	12	12½	23½	360.8	367.5	728.3	220	50	18	72	93	100	120	82	96	89	Miles P. Hr. 10.46
Up 4.0	2	118 (Mean	116.5 117.25)	103	10½	10	23½	348	361	709	260	48	18	73	93	98	110	82	96	80	15.0
Down 7.12	3	74 (Mean	95 84.5)	120	10	6	24	83	269.5	352.5	300	58	20	72	84	102	220	72	94	86	8.33
Up 4.34	4	74 (Mean	99 86.5)	150	10	9½	22	72.9	312	384.9	230	39	24	72	88	86	95	88	94	84	13.13
Down 5.53	5	102 (Mean	100 101)	140	11	11	23	317	311.5	628.5	240	37	19	72	94	104	200	72	91	88	10.19
Up 3.59	6	110.5 (Mean	107 108.7)	142	11	11	23	349.5	342	691.5	250	38	20	..	94	112	160	75	..	..	15.06
Down 5.02	7	116 (Mean	115 115.5)	149	17	17	23	434	448	882	250	39	22	73	110	120	140	75	..	..	11.92
Up 3.54½	8	117 (Mean	114 115.5)	145	17	17	22½	428	435	863	260	38	18	72	99	110	180	..	..	..	15.35
Down 4.51	9	118.5 (Mean	116 117.2)	150	19	19	22½	453	446	899	..	..	..	..	...	...	...	..	..	..	12.37
Up 3.54	10	119 (Mean	117 118	149	18	18	22½	468	454.2	922.2	250	38	21	73	100	106	200	..	..	..	15.38
Down 4.45	11	119.5 (Mean	116.5 118)	145	17½	17½	22¾	482	458	940	...	..	..	..	...	...	..	..	..	..	12.63
Up 4.07	12	119.5 (Mean	116 117.25)	145	17½	17½	22¾	466.5	448	914.5	250	39	20	73	100	104	210	..	..	..	14.57

Note.—L. P. linked up 1″ on all runs.

pendent circuit and switch, and the forward capstan being connected on the circuit to the winches.

There is installed forward on the main deck, just aft of the hawser pipe openings, a 7 by 6-inch vertical combined steam and pump brake windlass of the Hyde Company's make, with double bits and special auxiliary shaft for quick speed of the gypsy heads. The windlass and engine are galvanized throughout, and a friction band and locking gear are provided. There is a heavy 9½-inch cast steel sprocket between each gypsy head and bearing, with a friction clutch suitable for operating messenger chains to the winding-in cable drums.

The table shown in Fig. 9 gives full account of the standardization runs that were required by the Government, while the speed curves and slip of propeller are shown in Figs. 10 and 11.

MACHINERY AND PIPING ARRANGEMENTS—III.

BY JOHN M'COLL.

In beginning a piping arrangement, the usual procedure is, first, to fix the number of views of the machinery and machinery space required to show clearly all the pipes and fittings, then to arrange these views to the best advantage on the drawing paper and drawing boards available. In ordinary merchant ships these views will include at least a plan and a profile the whole length of engine and boiler rooms, showing part of the tunnel, if that is used for refrigerating machinery, a section in way of the engine room and one in way of the boiler room. Shipside views, showing the auxiliaries, sea suction and overboard discharge valves, etc., are usually added. For twin-screw vessels the profile or elevation should show the engines and boilers looking to the starboard side; that is, looking on the back of the starboard engine and on the starboard boiler. A separate shipside view of the engine room (omitting the engine) looking to port side will then be required. More sections and part views will certainly be needed for large jobs.

The scale most favored for arrangement drawings is ½ inch to the foot; ⅜ inch to the foot is sometimes used for large arrangements, and does very well. One-quarter inch to the foot is occasionally used, but cannot be recommended except for simple arrangements, and where most of the smaller pipes are to be made to place. Where, as in some cases, all pipes down to, say, 1½-inch bore, are to be ordered by sketch, and below that bore, by giving approximate lengths and where the arrangement is likely to be complicated, ½-inch scale should if possible be adopted.

Having settled the number and arrangement of views to be given, the shipwork is first drawn in; then the engines, boilers and auxiliaries. It will depend on the method of carrying on the job how much of each of these items is shown in at the beginning. One of two methods may be taken. The main systems, that is, the steam and exhaust, suctions and discharges, and bilge and ballast arrangements, may be drawn complete on tracing paper or cloth, and all pipes and fittings ordered from these tracings before putting any part of them

NAME OF AUXILIARY	STEAM					EXHAUST					SUCTIONS												DISCHARGES													
	BOILERS DIRECT H.P.	BOILERS DIRECT REDUCED	AUXILIARY SYSTEM H.P.	AUXILIARY SYSTEM REDUCED	AUXIL'Y SYSTEM CONTROLLED	MAIN CONDENSER	AUXILIARY CONDENSER	ATMOSPHERE	MAIN CONDENSER DIRECT	AUXILIARY CONDENSER DIRECT	SEA	HOTWELL	BALLAST TANKS	BILGES	BILGES DIRECT	RESERVE TANK	BOILERS	MAIN CONDENSER	AUXILIARY CONDENSER	FILTERS	FLOAT TANK	FRESH WATER TANKS	MAIN BOILERS	AUXILIARY BOILERS	FLOAT TANK	FILTERS (THROUGHOUT)	FEED WATER HEATER	MAIN CONDENSER OVERBOARD	AUXIL'Y CONDENSER OVERBOARD	OVERBOARD DIRECT	BALLAST TANKS	SANITARY TANK	FRESH WATER TANKS DECK	DECK. & FIREMAIN	ASH EJECTORS	DISTILLERS
MAIN CIRCULATING PUMP			1½						2		12				8													12								
AUXIL'Y CIRCULATING PUMP				O						O	O																		O							
MAIN AIR PUMP			O			O	O	O										O																		
AUXILIARY AIR PUMP				O		O	O	O											O																	
MAIN FEED PUMP			O		O	O	O	O				O				O	O			O	O		O	O			O									
AUXILIARY FEED PUMP			O	O	O	O	O	O			O	O				O	O			O	O		O	O			O									
BILGE PUMP				O		O	O	O			O			O	O															O		O		O		
SANITARY PUMP				O		O	O	O			O		O																			O		O		
FRESH WATER PUMP				O		O	O	O								O						O											O			
BALLAST PUMP				O		O	O	O			O		O	O	O													O	O	O	O					O
ASH EJECTOR PUMP	O					O	O	O			O																								O	
GENERAL SERVICE PUMP			O			O	O	O			O	O	O			O						O		O						O		O	O	O		
FEED HEATER			O									⊗ Drain																								
FEED FILTER																																				
DYNAMO ENGINES		O						O	O	O																										
STEERING ENGINE		O				O	O	O																												
ASH HOIST ENGINE				O		O	O	O																												
EVAPORATOR			O						⊗ Vapor																											
EVAPORATOR PUMP				O		O	O	O																												
FORCED DRAFT FANS	O					O	O	O																												
REVERSING ENGINE	O								O																											
TURNING ENGINE				O		O	O	O																												
REFRIGERATING PLANT				O		O	O	O																												
WINCHES				O				O		O																										

FIG. 14.

on the drawing proper. On the other hand, each system may be roughed out fairly accurately on tracing paper, put carefully into the main drawing, and the material ordered from the drawing. In any case, the drawing when completed should show all the pipes and fittings as finished in the ship. Notes should be taken during the progress of the work in the ship, and corections made, so that should replacing or renewals be required the drawing can be referred to with confidence. The bilge and ballast system need not be shown in the main drawing, as since this is about the first engineering work to be done on board, the arrangement has to be finished separately and sent out early. Further, the ship's engineers are supplied with

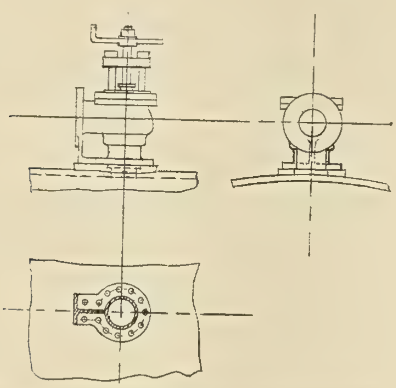


FIG. 15.—BOILER-STOP VALVE FOR MAIN STEM.

prints of the arrangement, and these are usually framed and hung up for reference in the engineers' mess room.

Before anything is done in planning pipes, etc., a diagram of "auxiliaries' connections" should be made out, as shown in Fig. 14. This will show at a glance what is proposed, and after approval what is being done. The connections and work of each pump may be clearly laid down in the specification, to ensure that certain duties will be done; but there may be another way than that specified for doing the same duty, which will at the same time simplify and reduce the number of connections and fittings. Reasonable suggestions to that effect are listened to, and may result in a saving to owner and builder.

Assuming that all requirements have been provided for, as shown in the diagram, the main steam pipes may come first for arrangement. Independent of the material or details of the pipes, the main leads should always have a slope, either up from the boilers to the engines or down from the boilers to the engines. The branch pipe from each boiler usually has to rise, but in any case water pockets are to be avoided, and each stop valve should be fitted with a drain valve. Lap-welded iron or solid drawn-steel pipes are the materials usually employed for the main steam pipes to the exclusion of copper. They are cheaper and stronger than copper pipes for the higher pressures, as copper loses much of its strength at the higher temperatures, due to the higher pressures.

The next point to consider, when the draining has been arranged, is the method to be used for taking up the expansion. Up to 6-inch bore bends may be used, but they should be more than a simple right-angle bend, unless the straight parts are long, otherwise expansion boxes are necessary. Where the pipes are large the stop valves on the boilers should be specially anchored. If a direct thrust is given, a wrought iron stay behind the valve should be fitted, or a bracket cast on at the back; but where the tendency of the expanding pipe is to twist the valve round, the flange joining the boiler should be extended below the pipe flange, as shown in Fig. 15. Expansion boxes are usually made of cast iron or cast steel for the larger sizes, with brass sleeves, glands and neck rings. In the smaller sizes the neck ring may be omitted, and the gland made of cast iron. An arrangement having bends only is shown in Fig. 16, and a combination of bends and expansion boxes is shown in Fig. 17.

In fixing the bore of the branch pipes from boilers to mains, the speed of the engines has to be considered, since if they are of the fast-running type, slightly increased areas should be given than would be used for slower engines. For ordinary slow-running engines the area of the main steam pipe to the engine is multiplied by 1.2 and divided by the number of boilers supplying that engine. In both cases the intermediate branch pipes should be ample, better rather more than the exact proportion.

The supply of steam to auxiliaries is usually taken indirectly from any boiler, and directly from two or more, preferably from those nearest the engine room. To determine the bore of the auxiliary steam pipe, make a list of those auxiliaries working steadily at sea, and a list of those working in harbor; combine the area of their steam pipes in each list separately and take the greater. The area may be further reduced, because there is less friction in one large pipe than in the smaller pipes for the same total area. The proportion taken may be

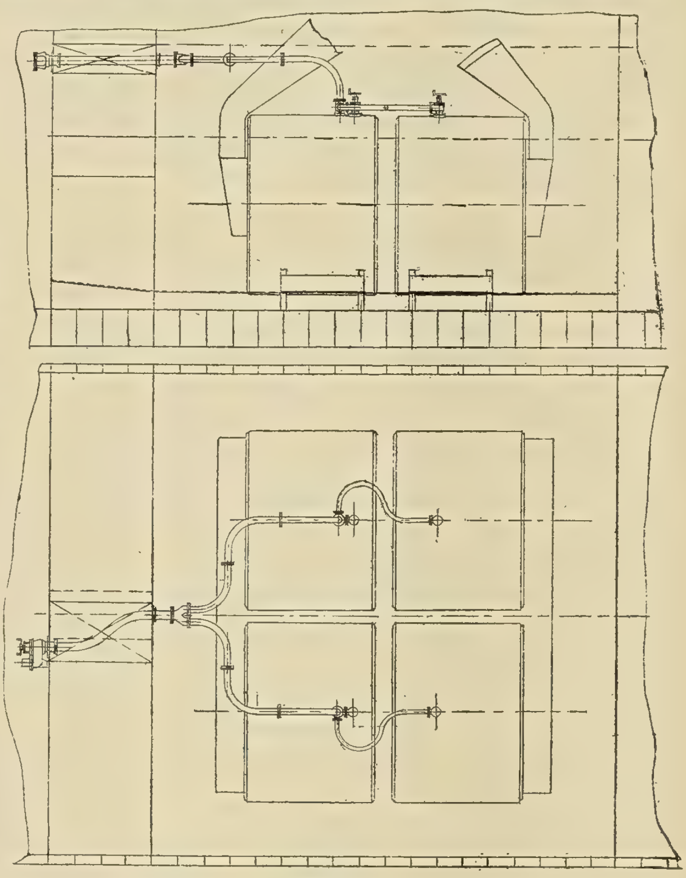


FIG. 16.

.8 of the combined small pipes. The size of the auxiliaries' main exhaust pipe may be found in the same manner. The auxiliaries' steam supply is usually divided into two ranges, as some work with full boiler pressure and others with reduced pressure. In these cases advantage should be taken in determining the bore of the auxiliary main of the increased volume of steam gained in reducing from the high to the lower pressure. As in the main steam line, the auxiliary system should slope one way and be without pockets. This may imply that the last auxiliary on a range of piping will receive the drain, but suitable provision can be made for that.

While it is not necessary to have a stop valve where the supply to each auxiliary leaves the main, it should be arranged that at least both sides of the engine room be independent, so

that should the supply to any one auxiliary have to be shut off, the whole engine room may not be involved. The same applies to the deck machinery. Those auxiliaries forward of the engine room should be independent of those aft. Stop valves and branch pieces for steam and exhaust will be to specification; but where the material is not definitely stated they can safely be made of brass up to 1¾-inch bore, and above that of cast iron, and as a rule has to be made for branch pieces, make all those with a 2-inch bore branch in them of cast iron. Steam branch pieces should have if possible the smaller branch inclined upwards, or be so arranged that the pipe comes from the top of the piece. Exhaust branch pieces should have the branches inclined, that the flow of steam will be in the direction of the main flow. Cocks should not be used where valves will serve, and care ought to be taken that the exhausts from fast-running engines are not controlled by cocks. The main feed pumps are supplied with high-pressure steam, controlled by a float tank, or heater float, for use at about flickering lights than through more serious inconveniences.

Steam pipes and fittings should be kept clear of the switchboard, so that drips and undue heat may be avoided. The steam supply to the steering engines is, by rule, kept independent of the supply to other auxiliaries. Where the distance is considerable and if there is much variation in the level of the piping a drain trap should be fitted at the lowest point. This will apply also to the exhaust piping.

The steam supply to galleys and heating systems, especially the galleys, is most important in some cases, and care has to be taken that no interruption takes places in the supply of these, even should other systems fail.

The exhaust or drains from the heating systems and galleys should be led along with the other drains to the hot well or float tank, that they may be passed through the filter. On long-voyage ships the saving of water becomes of importance, and an efficient drain system will be a great advantage.

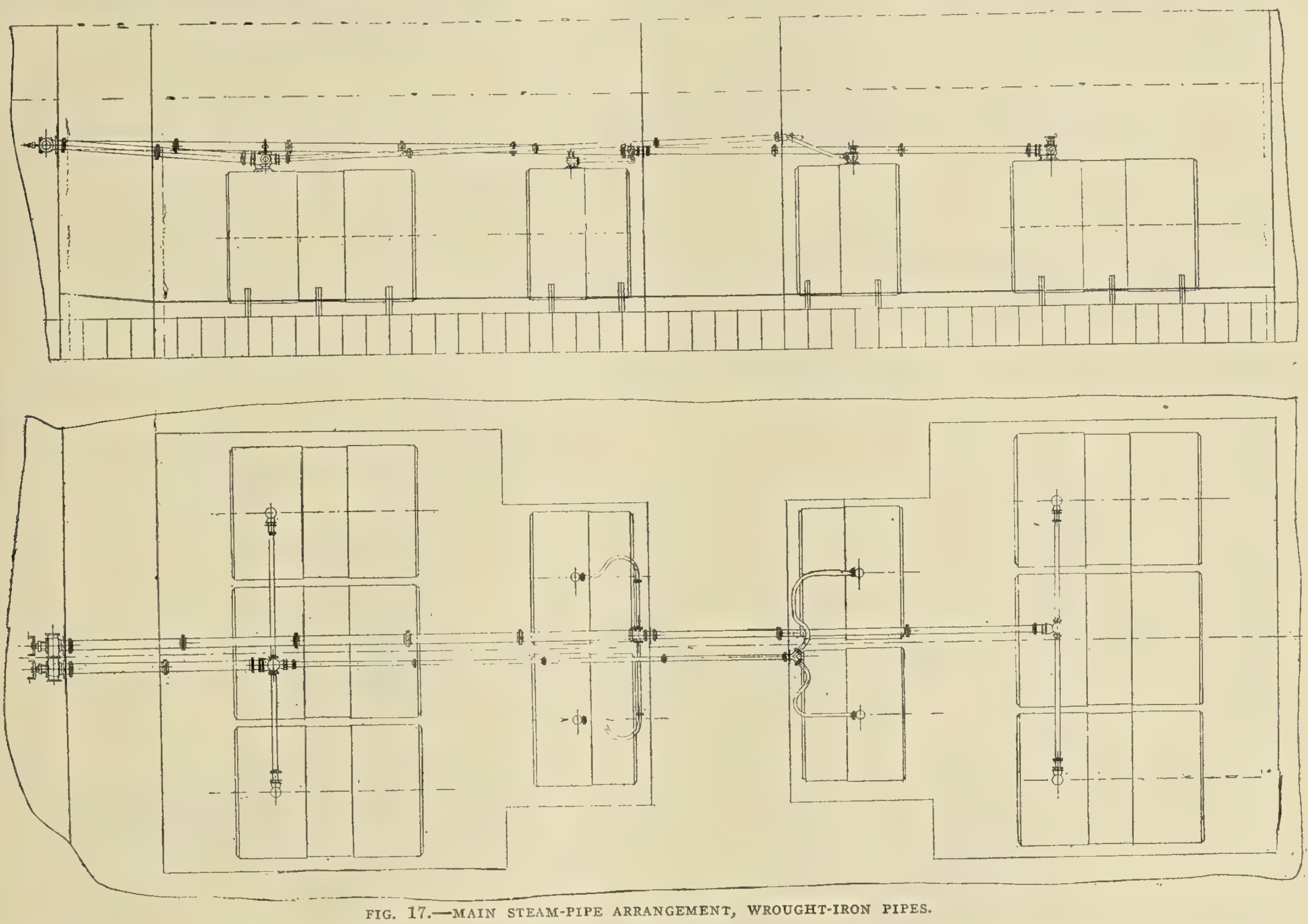


Fig. 17.—Main Steam-Pipe Arrangement, Wrought-Iron Pipes.

sea, and also supplied direct from the main system for use in harbor, or in case the float gear should be out of action. The auxiliary feed pump is also supplied with high-pressure steam, but if doing other duties besides supplying the boilers, should also have a supply of reduced steam. A non-return valve will be needed to prevent the high-pressure steam getting into the low-pressure system.

Where the exhaust steam is not used to heat the feed water it may go to the condenser or atmosphere, but the exhaust from the auxiliaries using high-pressure steam is of some value, and should be made use of in the low pressure or other receiver. The dynamo engines should have their steam and exhaust pipes quite separate from the other auxiliaries, and in addition should have a steam separator fitted. Indeed, all reasonable means must be taken to ensure steady running and steady light, as more trouble is caused through complaints

THE MARINE STEAM ENGINE INDICATOR—VI.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

PIPES AND COCKS.

A suitable indicator having been selected, it now becomes necessary to consider the matter of attaching it to the engine. If this is not properly done the precision of the best instrument will be of no advantage, and all the cards obtained will be untrustworthy. It is safe to say that all propelling engines of any considerable size are fitted with indicator connections and reducing motions, and on many of the auxiliaries drilled and plugged holes will be found which are intended for indicator cocks. The sea-going engineer should not take it for granted, however, that these holes are properly located or that

the pipes and reducing motions cannot be improved. The designers and builders are not infallible, and probably in five cases out of ten they give less attention to the indicator appliances than to any of the other engine details.

If the engine to be indicated is not provided with connections, the whole arrangement should be worked out, sketched and dimensioned before a tool is touched. It is much easier to rectify errors on paper than it is to correct mistakes in metal working. The holes for the cocks should be located so that they will not be even partially closed by the piston when the engine is on the center. If necessary, short channel ways should be chipped in the cylinder cover, or cylinder bottom, of sufficient depth to maintain the full area of the pipe. The idea

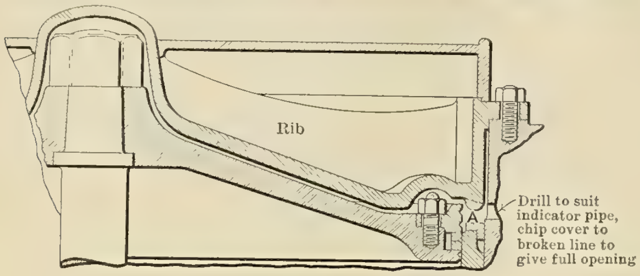


FIG. 43.

is shown in Fig. 43. The space *A* in the figure exceeds the area of the pipe, but part of the steam in flowing to and from the indicator is forced to turn through 90 degrees, and wire drawing, to a greater or less extent, is sure to result. When cutting channels it should be borne in mind that the cylinder covers and bottoms of moderate-size engines are either cored out or ribbed, and that the metal is seldom over 1⅜ inches thick.

In order to obtain a full and free passage to the indicator the holes for the pipes or cocks are sometimes tapped into the passages leading to the steam ports. This is the worst possible location on the whole casting. If the holes are partly closed at the end of the stroke, the diagram drawn by the instrument will be affected at the ends only, but with the instrument connected to the steam passages—or even near them—the steam and exhaust lines will be untruthful, and the horsepower shown on the card will be made lower than the actual power developed.

The writer remembers the case of a steamer whose contract called for some 8,000 indicated horsepower and 17 knots speed.

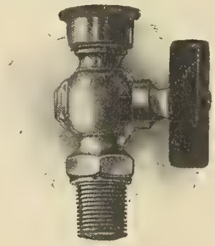


FIG. 44.

On the preliminary trial the vessel made the required speed but only about 7,000 horsepower. This was a serious matter, as a heavy penalty had been prescribed in case of a failure to show the required power. As the engine had made the designed number of revolutions the indicators were suspected, and an expert was called. He found the indicator pipes tapped into the steam passages. The pipes were relocated in correct positions. On the official trial, with the same revolutions as before, the builders earned a premium for developing more horsepower than the specifications required.

It is also bad practice to locate the pipes directly opposite the steam ports, particularly in small, quick-turning engines, as the steam has more or less inertia, and is liable to cause a false reading, especially if the indicator connection is short and direct. The best position for tapping the hole is about 100 degrees from the center line of the ports. Pipes taking steam at this point are less liable to have the pressure in them affected by steam current and eddies. This position may, of course, be modified to suit the cord-lead from the reducing motion, as guide pulleys are objectionable; but the holes must be kept clear of the ports at all costs.

When drilling holes it is always best to remove the pistons and make a proper job, but if this cannot be done the engine may be shored, so that it cannot move, and about 5 pounds pressure put on the cylinder. The pressure may be judged by opening the drain, or it may be known accurately by attaching

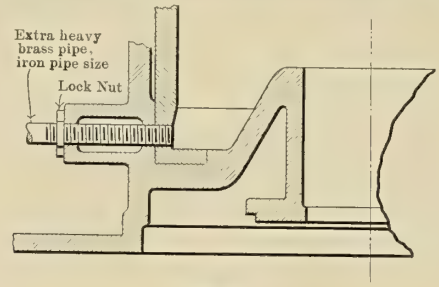


FIG. 45.

a gage outside of the drain valve on the end of the cylinder which is being drilled. The moment the drill point pierces the cylinder wall the jet of issuing steam will blow the hole clear, and will keep all borings out of the cylinder itself.

The centers of the holes having been located, the layout of the cocks and pipes should be taken up. When accuracy is of importance, a pair of instruments must be used, each instrument being connected to a cock similar to Fig. 44, which has been screwed directly into the hole drilled in the cylinder casting, or into a straight pipe, just long enough to clear the lagging. Fig. 45 shows such a pipe attached to the bottom end of a steam-jacketed cylinder. Unless the indicator is of the

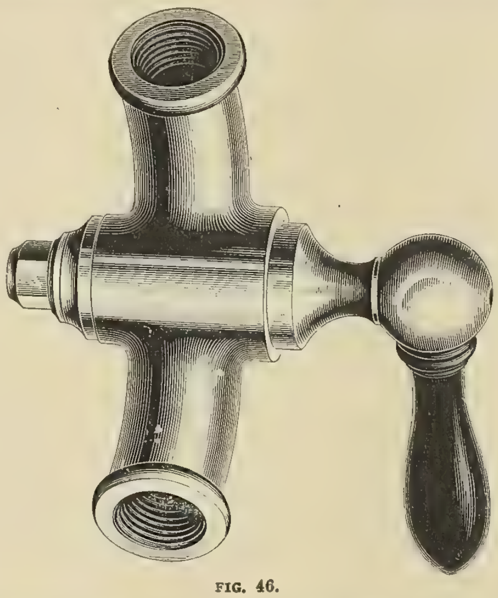


FIG. 46.

type shown in Fig. 37 (December, 1909, issue) this connection will bring the indicator drum-axis in a horizontal position. The manipulation of an instrument attached in this manner is somewhat unhandy, but the increase in accuracy is worth the trouble. The next best thing is to use a cock of the type shown in Fig. 46.

If two indicators for each cylinder are out of the question, the side pipe and three-way cock (Fig. 47) must be used. This cock is made especially for marine engines, and is fitted with

1-inch pipe connections. No important deductions should be made from an indicator connected up in this manner, as the diagrams are inaccurate, especially if the stroke of the engine is long. On engines running with a steady load, such as a dynamo engine driving a ship's lighting plant, a very good correction can be computed by taking a diagram from each end of the cylinder with a short direct connection, and then

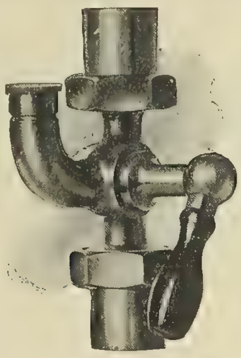


FIG. 47.

taking a set with the three-way cock and side pipe, and the difference noted. If this operation is attempted, care should be taken to have the steam, voltage and current the same when the cards are taken. In the case of small engines, the pipes should not be over ½ inch inside diameter, because the pipe adds to the volumetric clearance, and this in turn distorts the diagram. On large engines the pipes may be increased to 1 or 1¼ inches inside diameter with advantage, as such pipes tend to do away with friction and do not sensibly affect the clearance volume.

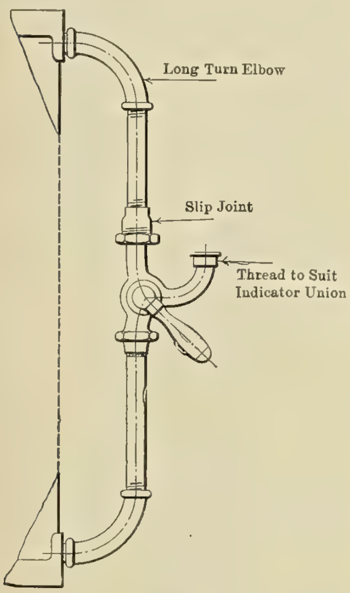


FIG. 48.

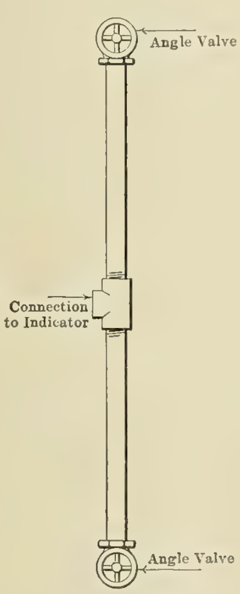


FIG. 49.

The arrangement should be about as shown in Fig. 48, the bends being as long and easy as practicable, and the cock located in the middle of the length of pipe. The arrangement illustrated in Fig. 49 is particularly bad, and should never be used. Either one of the angle valves may leak or be left partly open, and in any case the entire pipe has to be filled at each revolution. A diagram taken with this form of connection will indicate large clearance, deficient lead and obstructed steam ports when these defects do not exist. Brass pipe should be used in fitting up. The burrs caused by the pipe cutter should be removed with a reamer, and red lead paint and other kinds of pipe "dope" omitted. A small particle of hardened red lead or other foreign substance on the indicator piston will sometimes cut queer figures on the diagram. Oil should be used in making up the joints, and if the leaks persist they can be easily stopped by winding a strand of cotton waste in the pipe thread. The pipes and cocks should be blown through with live steam, both before and after connecting up, and the openings kept carefully plugged or capped after the job is completed.

(To be continued.)

THE U. S. COLLIERS MARS, VULCAN AND HECTOR.

On May 13, 1908, the United States Congress appropriated $1,575,000 to buy three colliers, with a cargo-carrying capacity of approximately 7,200 tons dead weight each. The Secretary of the Navy being authorized to make the purchase, issued a circular stating the particular features required and the maximum time of delivery, asking for bids to be opened on June 1, 1908. The Massachusetts Steamship Company and several ship-building firms offered to furnish these boats, the Massachusetts Steamship Company being the only bidder who had the ships built and could deliver them immediately; the others were to construct them. These bids were all thrown out on the ground that they did not meet with the requirements of the circular and new bids asked. These were opened on Sept. 1, 1908. The Maryland Steel Company was the lowest bidder offering to build the three ships for $1,138,800 and to deliver then in ten, eleven and twelve months. These ships, the *Mars, Vulcan* and *Hector*, have just been delivered to the government by the above company after having satisfied the requirements of the contract.

They are single-decked self-trimming vessels, with poop bridge and forecastle, with a pilot house above the bridge, two masts and ten derrick posts; each having two booms, arranged to lift hatch covers and to handle cargo. There are ten large hatches with steel covers, especially fitted to be water tight. A double bottom runs from the after boiler room bulkhead to the forward peak bulkhead, and upper wing ballast tanks are formed in the triangular space between the deck and the side, outboard of the cargo hatches. The machinery space, containing four Scotch boilers, two triple-expansion engines and auxiliaries, is placed aft. The bunker coal is carried in longitudinal bunkers abreast the boilers and on the main deck around the boiler casing. A donkey boiler is located on a flat forward in the boiler room. Fresh-water tanks are in the engine room, while a refrigerating plant is located on the main deck aft. The officers' quarters are in the bridge house, the engineer's in the after-deck house on the poop deck, and the crew on the main deck aft. The forecastle contains the windlass engine and storerooms. The hull and machinery are constructed in accordance with the requirements of the American Bureau of Shipping for their highest class.

THE HULL.

The principal dimensions are: length between perpendiculars, 385 feet; length over all, 403 feet; beam molded, 53 feet; depth, 32 feet 6 inches; draft, 24 feet 6 inches; speed, loaded, 12 knots. The upper stem is bar steel and the lower cast steel, efficiently connected to the forward keel plate; the stern post is cast steel of channel section, with an opening for the propellers, and extends into the hull to efficiently connect with the keel plate. Hangers for the shafts are bolted to the main piece. The rudder is of the built-up type of wrought steel, connected to a 10-inch diameter extension stock by a flanged coupling bolted, the weight being taken by a bearing on the main deck.

The keel is a flat plate 36 inches by 35 pounds, the center keelson 22 pounds 48 inches high, connected to the keel plate by double angles 6 inches by 4 inches and to the tank top by

THE COLLIER MARS.

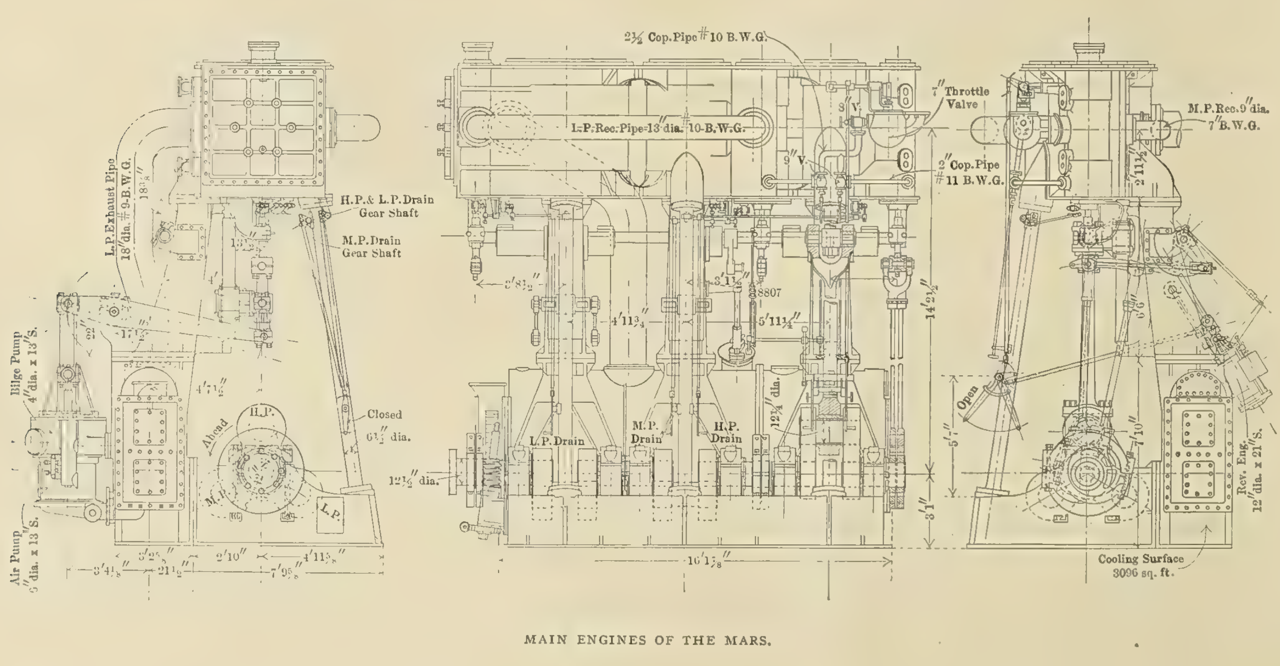
4-inch by 4-inch angles. The frames in the water bottom are 3½-inch by 3½-inch angles, between the margin and top side tanks 10-inch by 3½-inch channels split at the bilges, and bracketed to the top side tanks, at the ends they are 8-inch by 3½-inch bulb angles, in one piece from center line to deck, in the top side tanks 7-inch by 3½-inch angles, in way of erections 6-inch by 3½-inch angles, and the bulkhead frames are double 3½-inch by 3½-inch angles; all spaced 26 inches. The reverse frames are 3½ inches by 3½ inches by 10 pounds by 9 pounds in one piece from center line to margin, double in the machinery space.

There are solid floors on every frame 18 pounds to 15 pounds at ends, increased in the machinery space. Two intercostals are on each side of the center line, 17-pound plates amidship to 15-pound plates at the ends, they have large lightening holes and the necessary limber and air holes.

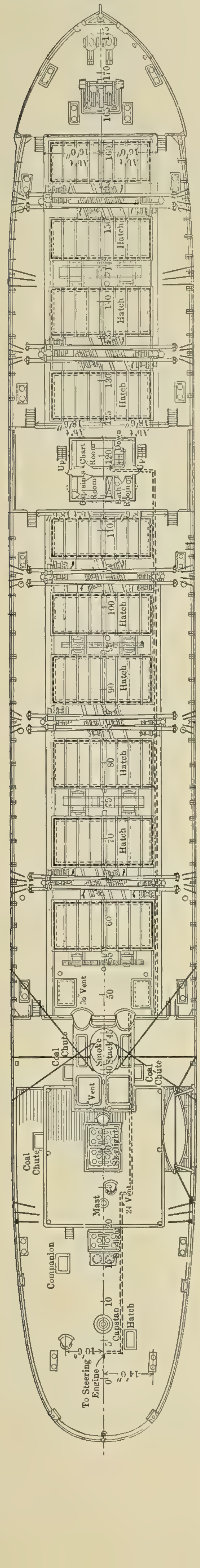
The tank tops, 19 pounds amidships to 16 pounds at the ends, with the butts lapped and double-riveted seams, single-riveted in the cargo spaces, the hold ceiling of 2½-inch yellow pine is laid on 2½-inch yellow pine battens.

The margin plate is 19 pounds amidships to 17 pounds at the ends, fitted in a straight line between butts. The top side-tank stiffeners are 7-inch by 3½-inch angles, the ties 6 inches by 3½ inches and the plating 17½ pounds. Two side stringers are fitted built of 10-inch by 3½-inch channels, with 20-pound intercostal plate. The shell is built on the clinker system on the bottom and in and out on the sides; the bottom is 24 pounds, the bilge 26 pounds, the sides 24 pounds and the sheer 26 pounds, all reduced at the ends, the sheer strake retaining the same thickness through the machinery space.

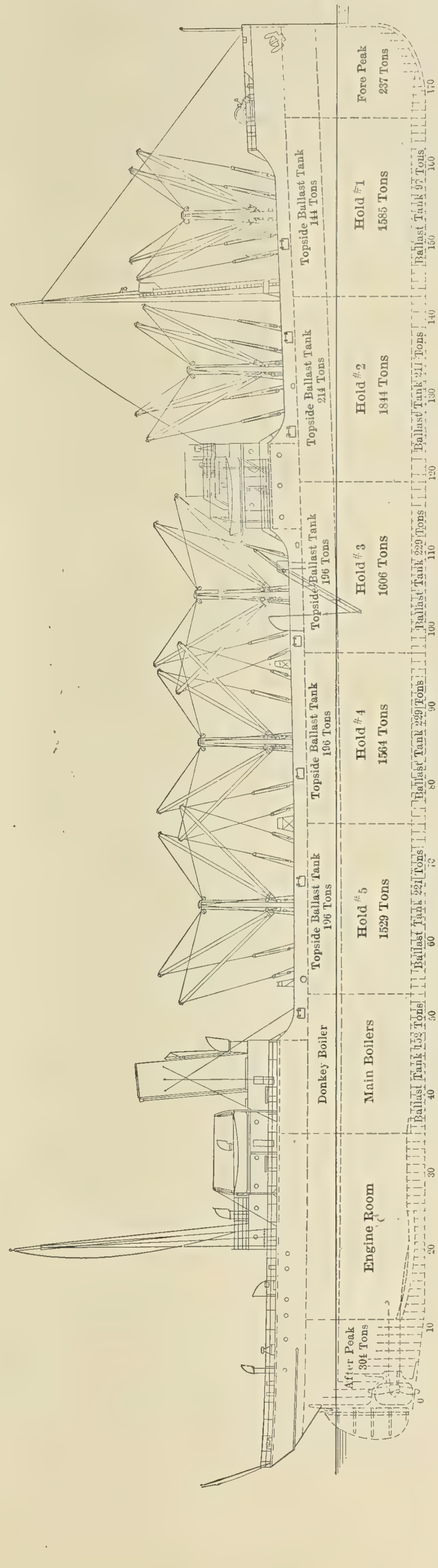
A bilge keel of 10-inch bulb angle and 3½-inch by 3½-inch angle extends throughout the parallel portion of the hull. The main deck stringer is 66 inches by 25 pounds, the plating is 17 pounds, both reduced at the ends, and the beams are 12-inch channel, spaced on alternate frames. In way of hatch openings they are 8-inch by 3½-inch channels on alternate frames, with 7-inch by 3½-inch intermediates. There are seven bulkheads, which divide the ship into eight water-tight compartments, built of 17 to 14-pound plates stiffened with vertical flanged plate and 10-inch bulb angles bracketed top and bottom. Also there is one non-water-tight bulkhead between the engine and boiler rooms. The forecastle bridge and poop in general are constructed of 15, 16 and 14-pound stringers, 12 and 14-pound plating, and beams of 7-inch by 3½-inch and 10-inch by 3½-inch channels. The hatch coaming is 21-inch by 20-pound plate attached to an 18-inch plate that forms the inner end of the top side tank, making a total height above deck of 39 inches.



MAIN ENGINES OF THE MARS.

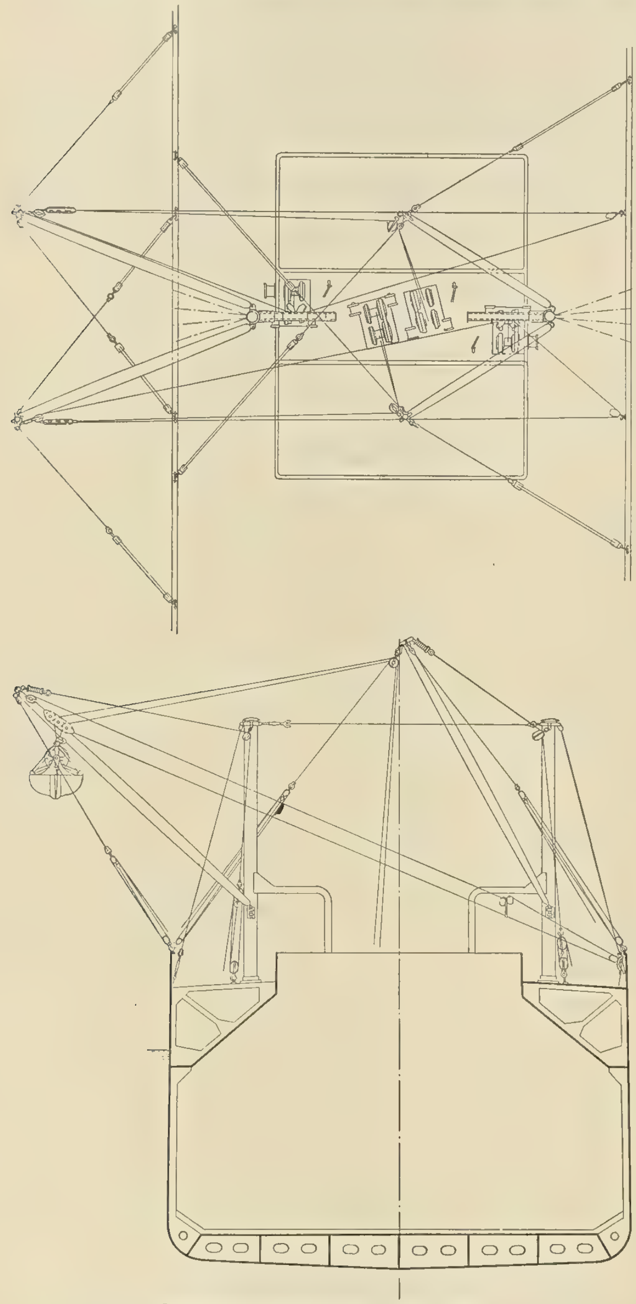


DECK PLAN OF THE MARS, SHOWING ARRANGEMENT OF HATCHES, CARGO BOOMS AND WINCHES.



INBOARD PROFILE OF THE MARS, SHOWING ARRANGEMENT AND CAPACITIES OF HOLDS AND TANKS.

One of the most important features of a vessel of this class is the coaling gear. These colliers are fitted with the Lidgerwood Miller marine transfers. The decision of the Navy Department to equip the colliers with this gear was reached after the contract for the ships had been let to the Maryland Steel Company. Before the winches were selected for the colliers *Vestal* and *Prometheus* a competitive test was held in the New York Navy Yard between a very fine winch with wood and iron frictions, built at the Norfolk Navy Yard,



ARRANGEMENT OF COALING APPARATUS.

and a new type of winch, offered by the Lidgerwood Manufacturing Company, of New York.

The introduction on board ship of machinery to operate a clam-shell bucket (thereby dispensing entirely with the shoveling of coal in the hold) was new, and no ship's winch has ever been designed or constructed for this purpose. Deck space is valuable and limited, and the winches designed by the Lidgerwood Manufacturing Company occupy a space of only 7 feet 8 inches long by 5 feet 10½ inches wide. These winches have only 8¼-inch by 10-inch cylinders and yet they have proved capable of handling a 1⅝-cubic yard load (one gross ton of coal) with perfect ease and with an ample factor of safety. In shore coaling towers 10-inch by 12-inch cylinders are the smallest that are ever used with this bucket. Wood and iron friction drums are employed on shore towers very extensively and with success, but there is room there for them and they are of very large diameter, even 40 inches, 50 inches and 60 inches in some instances. The deck space available on the colliers limited the diameter of the frictions to something like 24 inches and the Lidgerwood Company regarded the use of wood and iron frictions as impossible for this service. Even their metallic frictions provided with air-cooling passages got extremely hot in the course of a run of one hour's duration. In the test at the New York Navy Yard the wood and iron frictions, in three hours' running, were rendered unfit for further service, having ¼ inch of charcoal on the wood.

The winches having been adopted for the *Vestal* and *Prometheus,* and the Lidgerwood Company standing ready to guarantee an output of 100 tons of coal per hour per hatch if the same system was installed on the colliers *Mars, Vulcan* and *Hector,* the Navy Department, therefore, decided to adopt them, and a subsequent contract was made with the Maryland Steel Company. The Lidgerwood Company was under a penalty of three hundred dollars per ton for each ship for every ton less than 100 handled from each hatch. Coal to the amount of 117 tons was discharged from one hatch on the *Mars* in one hour; 170 tons from the *Vulcan* and 190 tons from the *Hector.*

There were three important points not ignored by the Lidgerwood Company in the design and construction of these winches. First, the employment of the metallic slip frictions with air-cooling passages; second, the employment of the lever control, which made the operation comparatively easy for the operator; third, the position of the operator was such that he could see the bucket in all parts of the hold as well as in every position it might take above the hatch. One operator attends wholly to the closing, hoisting and lowering of the bucket, while the other attends wholly and exclusively to the swinging of the same. The booms are fixed. The bucket operates in a curved line in a plane athwartships.

The extraordinary success of this coaling gear is undoubtedly the beginning of a revolution in coaling our ships. At the present time our battleships are equipped with winches, booms and tackle, so that the sailors on the battleships can hoist coal in bags from the colliers or barges alongside. It is an extraordinary fact, as stated by Admiral Dewey, that at the time the fleet started on its journey encircling the globe that the entire available supply of 4-inch manila rope in the market was exhausted. The chief bill for cordage for the Navy Department is for manila rope used for coaling ships. If now, the clamshell bucket is introduced on all of our colliers it is clear that coal may be delivered in bulk at various parts of a battleship. Therefore, the necessity for winches and booms, and also for rigging on battleships, will disappear, because it is clear that the problem will then be one of taking the coal from piles on deck and shoveling it either to the chutes that are nearest the piles or shoveling it into bags or baskets and dragging them across the deck to other parts of the battleship. In the old method, also, the sailors were sent into the hold to shovel coal into bags, and it is worthy of note that the old colliers seldom delivered more than 25 tons of coal per hour per hatch, and even that required from 20 to 25 men. The *Mars* can easily discharge 1,000 tons of coal per hour—the work of a thousand men—and only twenty men will be required to perform this. Those twenty men must be better than the ordinary grade of sailor and they must be well drilled, and that is one of the problems before the Navy Department. To place twenty well-drilled men on a collier will represent a considerable increase in the expense of the

collier service. On the other hand, if the sailors from the battleships are sent aboard the colliers, logically they will have to learn the art of handling these winches before they can attain the guaranteed or a better capacity. One suggestion has been made and that is that each battleship in advance of its coaling send men aboard the collier to learn the operation of the gear, for it is claimed that it requires only about two days' practice of men who have an aptitude for that sort of thing.

The main engines are of the vertical, inverted-cylinder type, having cylinders 22 inches, 37½ inches and 60 inches diameter by 42-inch stroke. The high-pressure cylinders are fitted with working liners and 9½-inch piston valves. The intermediate-pressure cylinders have 19-inch piston valves and the low-pressure cylinders have the usual double-ported slide valves. The cylinder heads are cast iron, with checkered-steel false covers. All the pistons are iron castings. The high-pressure and intermediate-pressure are fitted with followers and snap rings, the low-pressures are fitted with followers, bull rings and spring rings, set out by steel "C" springs. The piston rods are 5½ inches diameter in body and packed with metallic packing. The main-valve stems and throttle-valve stems are also packed with metallic packing. The connecting rods are steel of the forked type, 8 feet center to center, having hard brass boxes for the crosshead pins, and cast steel, white metel-lined boxes for the crank pins. The crosshead pins are 6½ inches diameter by 7¼ inches long. The guides of the bar type are iron castings fitted with water circulation and cast steel slippers faced with white metal. The front columns are polished steel 6½ inches diameter, and the back columns are cast iron resting on the main condensers. The bed plate is of a deep box section, cast iron, in one piece and has six main bearings fitted, each 13¾ inches long. Each bearing consists of a cast iron semi-circular bottom box, which rolls around the shaft to remove, and a cast steel cap. Both cap and box are lined with white metal. The crank shafts are of the built-up type 12¼ inches diameter, in one piece. The crank pins are 12¼ inches diameter by 13¼ inches long between webs. The high-pressure webs are 8½ inches thick, the intermediate-pressure are 8⅞ inches thick and the low-pressure webs are 9¼ inches thick. The valve gears are of the "Stevenson Link" type, having cast iron eccentrics and straps, and steel eccentric rods with cast steel yokes.

The reverse engines are straight steam rams, 12 inches diameter by 21-inch stroke.

The built-in type of main condensers are fitted, having a total cooling surface of 6,192 square feet. Each condenser contains 1,212 ⅝-inch diameter brass tubes, No. 16 B. W. G. thick, tinned inside and outside, and fitted with screw ferrules in rolled-brass tube sheets. An air pump and two bilge pumps are worked from each low-pressure crosshead. Each air pump is 26 inches diameter of bucket by 13-inch stroke, and each bilge pump has a 4-inch diameter plunger with a 13-inch stroke.

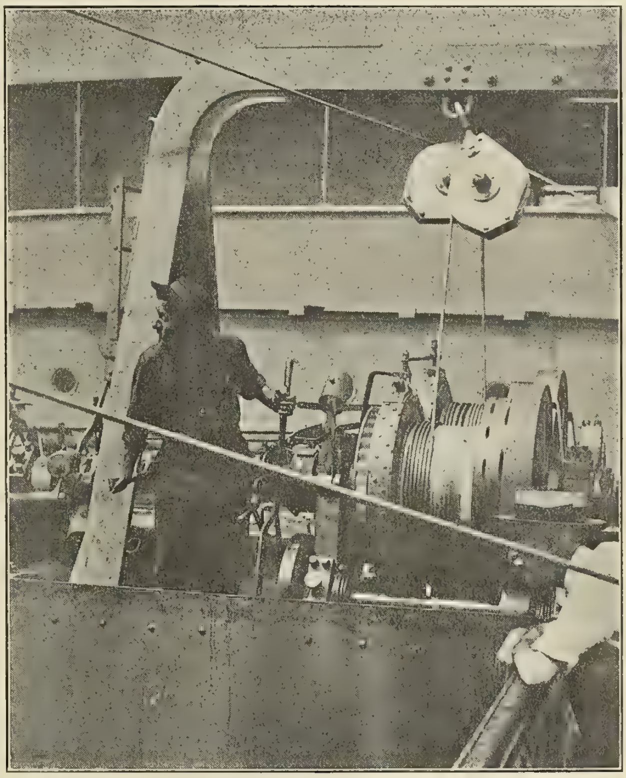
A double-cylinder 6-inch by 6-inch turning engine is located between the main engines just aft of the main bed plates, and connected to main shafts by double-worm gearing.

The thrust shafts are 12¼ inches diameter, each having eight 18-inch diameter collars. The shoes are cast iron, faced with white metal, and held in place on steel rods by brass nuts, permitting independent or collective adjustment. The whole block is fitted with water circulation.

As the main engines are well aft, there is only one piece of line shaft to each main shaft. These shafts are 11¾ inches diameter. The propeller shafts are 13 inches diameter, with brass sleeves throughout the entire length of the stern tube. The propellers are 14 feet 9 inches diameter and 14 feet 3 inches pitch, adjustable 3 inches either way. The hubs are of semi-steel, with cast iron caps. The blades are bronze.

There are four main boilers and one donkey boiler, built for a working pressure of 200 pounds per square inch. The main boilers are 15 feet diameter and 10 feet 9 inches long, designed and fitted for Howden's system of forced draft. The tubes are 2½ inches diameter, fitted with retarders. Each boiler contains three 44-inch inside diameter Morison flanged furnaces, with a combustion chamber to each furnace. The total heating surface is 10,200 square feet. The furnaces are fitted with cast-iron fronts, doors and grates 5 feet 4 inches long. The donkey boiler is a single-end Scotch, 8 feet diameter and 10 feet 6 inches long, having one 44-inch inside diameter Morison furnace.

The independent pumps consist of the following: Two vertical, simplex, main feed pumps, cylinders 14 inches, 10 inches by 24 inches; one vertical, duplex, auxiliary feed and fire pump, cylinders 10 inches, 7½ inches by 12 inches; one vertical, duplex, ballast pump, cylinders 12 inches, 14 inches by 12 inches; two vertical, duplex, fresh-water and sanitary pumps, cylinders 5¼ inches, 4¾ inches by 5 inches; one horizontal, duplex, evaporator feed pump, cylinder 4½ inches, 3¾ inches by 4 inches; one vertical, duplex, donkey boiler feed pump, cylinder 4½ inches, 2¾ inches by 4 inches, and two M. S. Company's make centrifugal circulating pumps, having 12-inch suctions and driven by vertical single 8-inch by 8-inch engines.



ONE OF THE LIDGERWOOD WINCHES INSTALLED ON THE MARS.

One 12-ton and one 5-ton Reilly evaporator, and one 15-inch Reilly distiller are also installed. A 36-inch Reilly feed-water heater and a 4-inch Blackburn-Smith grease extractor are fitted in the main feed lines. A Wheeler auxiliary condenser, having 1,000 square feet of cooling surface, is located in upper engine room. The two blowers for the forced-draft system are driven by vertical single 5-inch by 4-inch engines, and are also in the upper engine room. A 15-kilowatt Sturtevant direct-connected electric set complete, with switchboard, etc., has also been provided in upper engine room. A refrigerating plant of 800 cubic feet capacity is installed aft on main deck.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

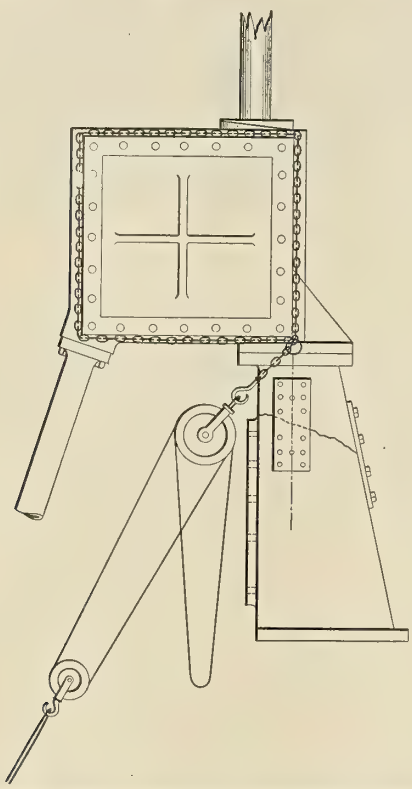
Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Fracture of a Back Column.

Some years ago, while a junior engineer on a vessel bound from Puget Sound to the Orient, rather an unusual accident happened to the engine. The captain was sailing the Great Circle course very late in the season, when, as Kipling puts it in McAndrew's hymn, "Fail there, ye've time to weld your shaft—ay, and eat it ere ye've spoke."

The engine was of the vertical compound-marine type. The back columns were of cast iron, resting on the condenser, and the front columns were turned wrought steel.

The accident happened just after midnight; the engines were racing, and the engineer on watch was standing by throttling the engine, when the vessel threw her wheel out of water. Shortly after taking the watch the second assistant noticed a bad knock in the low-pressure engine, shortly followed by the low-pressure crosshead and piston rod running hot. The engine was immediately slowed down and the chief called. Upon investigation the low-pressure back column was found to be broken off just above the crosshead guides, and the cylinder was jumping with every stroke of the engine. Before the engine could be stopped the other back column was in danger of breaking. Fortunately the low-pressure exhaust pipe was copper, and ran on an angle of about 45 degrees to the condenser, and therefore could stand being sprung.



ARRANGEMENT OF TACKLE AND BRACES TO SUPPORT FRACTURED COLUMN.

The bolts on the guides were slackened and the cut-off was run out on the high-pressure link, allowing the high-pressure engine to do most of the work, and the steam reduced as soon as possible. The engine was kept turning over slowly in an attempt to keep the vessel headed into the sea.

All hands were called, and a short cargo boom, about 6 inches in diameter, was procured from on deck, which was cut for a shore from the after corner of the low-pressure cylinder to the deck above. The piece of the boom that was left was placed horizontally under the deck to wedge against, with the shore and the ends of the same blocked, to distribute the load along several of the deck beams and to protect the hatch combing around the engine-room skylight. With this arrangement the revolutions were gradually increased, but it soon became apparent that this rig would not do much good, as the working of the cylinder loosened the wedges, and there was too much spring in the deck beams to shore against at this point, where they had been cut for the engine-room skylight. A chain sling was next passed over the end of the low-pressure valve chest, which was cast on the cylinder, and with a 2-ton chain tackle a strain was taken from one of the large foundation bolts, the nut of which had been backed off enough to pass a short wire strap around it under the nut. As the chain tackle was led on an angle from the crack (as will be seen in the sketch) it stopped most of the lateral motion of the cylinder, and the engine was run at half speed, just fast enough, with the aid of a few staysails, to keep her hove to. By morning the weather had moderated, and the captain and chief held a consultation, and decided that as we were over 1,200 miles from the sound, and it was a little over 4,000 miles to our destination, the vessel having weathered as bad a storm as we were likely to encounter, it would be better to make more permanent repairs and continue on our course. The engine was run at a little less than half speed while the following repairs were made. One watch made the repairs while the other two stood watch and watch.

Two spare, wide steel bearer bars were found stowed in the fire room, cut and drilled, as shown in the sketch; the holes were drilled away from the crack, owing to the fact that the metal was very thin there, which was responsible for the break, evidently caused by the shifting of the core in casting the column. One hole was drilled ⅛ inch larger than the bolts in each end of the pieces, and the two corresponding holes drilled the same in the columns for temporary bolts to hold the pieces in place while the other holes were being drilled through the plates into the columns, to make sure the holes would be in line, and we would have no trouble entering the bolts. The pieces were set to center lines on the column and on the plates. The holes were next drilled in the top part of the column, a neat fit for ⅞-inch rough bolts finished by hand. Next the temporary bolts were loosened, and the pieces dropped down three thirty-seconds of an inch, being careful to keep the pieces on the center lines, and the temporary bolts again set up, and the holes drilled in the bottom part of the column. (In this way the holes in the column measured just three thirty-seconds more from center to center than the holes in the plates.) Next a hand-hole was cut in the back of the column, where the metal was thin, to put the bolts in place. The engine was then stopped, with the bolts all started in the holes, so that they could be instantly tapped into place; the side plates were heated in the furnace almost to a white heat (to elongate the plates the three thirty-seconds difference

* We pay for these articles.

from center to center between the holes in the plates and in the columns), and brought in with tongs and held in place with drift pins. The bolts were tapped into place, and the nuts held in socket wrenches screwed on and set up. When the side plates had cooled they brought the broken columns together, so that the break could hardly be found if it had not been for the cracked paint.

A large thin plate was then screwed on the back of the column with tap bolts, but not heated. It took a little over thirty-six hours to complete the repairs, during which time the engine was only stopped one hour, and that was while the hot plates were being put in place.

While it is true that columns do not break often, the same principle can be applied to other parts of the machinery in cases of emergency, where it is impossible with the tools on board to bring broken pieces together, or in tight places, where there is no room for a jack and nothing to jack against—a predicament so often found on board ship.

U. S. S. *Mackinac*. LT. J. W. GLOVER.

Supplementing Babbit Metal for Iron Castings in Breakdowns at Sea.

When a ship proceeds to sea there is hardly any indication of breakdowns; nevertheless every engineer should devote part of his "off watch" hours studying some method which would prove solid and substantial in effecting repairs to the different parts of his engines, should they become damaged or broken in any way while at sea. Most engineers would be at a loss at first in many instances, and as repairs must be started without a great deal of "head scratching" and wondering, I will relate as an instance the experience we had on board the steamship *Elmoro* immediately after leaving Valparaiso, Chile.

While in Valparaiso for a few days the general routine of port overhauling was being performed, along with expanding the rings of the high-pressure valve. Everything was finished in due time, and the day following we sailed. We had not proceeded very far when suddenly a sharp, cracking sound was heard in the high-pressure cylinder or thereabouts. The idea of proceeding was out of the question, so we stopped for an examination. On removing the high-pressure cylinder head and follower ring we found them all right. Next, the high-pressure valve bonnet was removed, and to our dismay the top ring of the piston valve was cracked in half a dozen places.

How were we going to make lasting repairs without working "compound"?

I must admit, after someone received the chief's "grammar" for expanding the ring too much and causing it to grip the walls of the chamber, we started a little of the aforesaid "head scratching." That did not better conditions any, so we eventually thought of casting a new ring, and this is how it was done.

Having several new babbited spare brasses and a small amount of scrap babbit, we decided to make a casting from this source. First, we made two wooden boxes, one with a bottom; one without, each 8 inches deep and about 16 inches square. While one man was making the boxes another was removing the broken ring. The pieces were matched together in their original positions, and a circular ring of wood 1½ inches thick with a large hole in the center was made to fit the interior circumference of the ring and then placed half way down in the ring. Each broken piece had one or two ⅛ inch holes drilled through it and slightly countersunk along a center line around the ring's circumference. Through these holes the pieces were nailed fast to the wooden ring inside. See Figs. 1 and 2.

Then a single thickness of canvas was glued around the ring, with a layer of wrapping paper glued outside to insure a smooth pattern. The canvas was placed there in order to make a casting slightly larger, allowing for finishing to proper size.

In the meanwhile some fire-clay was being prepared for the mold. This should only be damp, just sufficient to keep itself in form.

When everything was ready and the babbit had been melted out of the brasses, we placed in the bottom of one box enough clay to keep the pattern up to the middle line of the wooden ring and top edge of the box. Clay was packed around the ring (Fig. 3), both inside and out and smoothed


⅜" Holes for nails

Fig.1
BROKEN RING

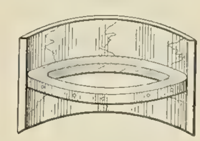


Fig.2
SECTIONAL VIEW SHOWING WOODEN RING INSIDE

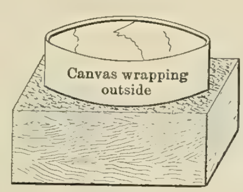


Fig.3
PATTERN IN BOTTOM BOX

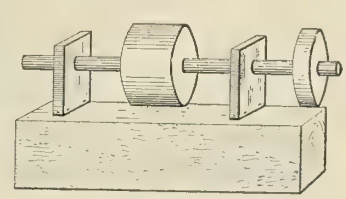


Fig.4
OUR "LATHE"
STEADY REST NOT SHOWN

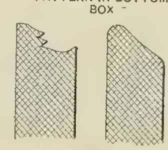

BROKEN END AND GROUND TOOL

Fig.5

off even at the edge of the box. Over this surface a layer of paper was placed to prevent the clay in the top box from sticking to that in the bottom.

The other box was placed on top perfectly square with the bottom box and clay packed all around the ring up to the top. Now, the top box was tapped lightly all around its sides and lifted vertically away from the ring. Similar tapping on the bottom box loosened the ring sufficiently to be removed clear of the mold.

The impression made by the wood ring was neatly patched up so no metal would run into it. We then made a "gate" hole and vent in the top box and replaced it in its exact position again. We were then in readiness to cast. A few pounds of iron were placed across the upper box to prevent it from lifting when the metal reached the top in pouring.

After a new ring was cast and allowed to cool, the job of finishing it to a true circle was undertaken.

Filing it was unreliable, so more accurate means had to be thought of. Something in the form of a lathe was what we needed. Not having any aboard ship we had to make something that would answer in a crude way.

Two circular pieces of wood were cut to a moderate driving fit to the inside diameter of the babbit ring. These were then driven in each end like the heads of a common barrel. With a pair of hermaphrodite calipers we easily found the exact centers, and through these we bored 1½-inch holes to allow a wooden shaft to be shoved through. This wooden shaft was the chief's curtain pole and was perfectly straight and true.

We next constructed a base and journals. The base was a heavy block of wood about 16 inches square and 4 feet long. The journals were two plain pieces of wood 12 inches wide,

2 inches thick and 12 inches high. Each of these, of course, had a $1\frac{1}{2}$-inch hole drilled through to receive the ring and shaft.

The journals were then slid on the shaft and securely nailed to the base. (Fig. 4.) A pulley 10 inches in diameter, 3 inches wide, was made also of wood and driven on one end of the shaft.

This makeshift lathe was carried around to the circulating engine, which was to supply us with power, and the pulley of our lathe placed in line with the shaft coupling on the engine. The lathe was secured to the floor plates by blocking the base with a few spare pin and journal brasses. A belt was made from a strip of canvas, sewed together at the ends.

The lathe was finished—now we needed a hand-trimming tool and a steady rest. The tool was made by breaking the end off a flat file and grinding it to the shape of Fig. 5. A steady rest was obtained in the shape of a piece of wood nailed from journal to journal, with its top edge on a line with the center of the shaft.

We were now ready to operate our "machine shop." The circulator was started slowly, and the act of turning down the ring was under way. Everything worked without a hitch and the ring was turned down to the exact size by hand in a short time.

When it was finished we removed it from its gear and screwed it on the valve casting and lowered it in the chamber. That finished our sea job, and we were in a few moments "full speed ahead" with the new ring working admirably.

Never did it give us the least trouble in any way, although it was examined at each port of call on the voyage. At the end of the run the wear was hardly noticeable, and we received congratulations from the superintendent engineer for our versatility in effecting such a good repair job.

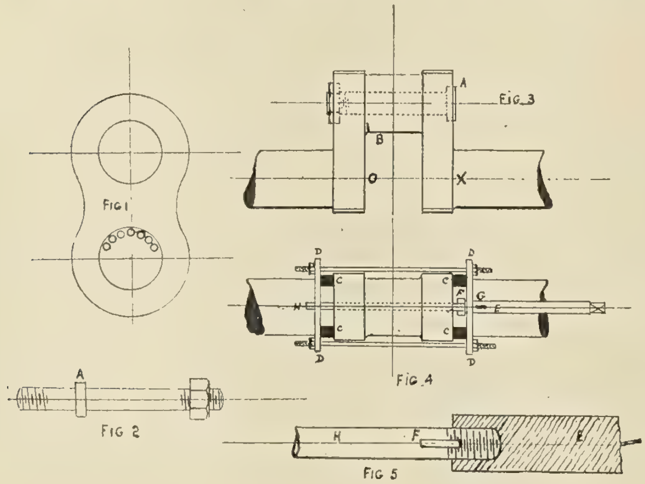
F. J. W.

Two Repairs to Crank Shafts.

MAKING GOOD A LOOSE WEB ON A BUILT CRANK SHAFT.

The crank shaft had been kept under observation, as a certain amount of slackness had been noticed between the shaft and the web. Later on, when at sea, knocking was heard, and it was located in the loose web. The repair was effected by drilling a number of holes round the end of the shaft, as shown in Fig. 1, and fitting taper screw pins, $1\frac{3}{8}$ inches diameter, in each hole, and screwing them up as tightly as a key with a good leverage would accomplish. $1\frac{3}{8}$ inches was the size of the largest screw tap on board.

Holes were drilled in the end of the shaft for about one-third of its circumference, as shown in the figure; the line of the holes being arranged to leave $\frac{1}{2}$ inch of metal between them and the edge of the shaft. The holes were drilled 6 inches deep, and screwed with taper tap only. Each hole and pin was finished, and the pin screwed up as far as it would go before commencing the next. The line of screwed pins swelled the shaft in the neighborhood of the holes, and tightened the shaft in its web sufficiently to carry the ship to her home port without further trouble. When arrived in port a new shaft end was fitted to the existing web. The possibility of this being done, and so avoiding the expense of new shaft and web, had been foreseen when the method described above was adopted. If plugs had been fitted interlocking the shaft and web, apart from the fact of their liability to slack back when at work, a new shaft and a new web would have been required on arrival home.



A FLAW IN THE FILLET OF A CRANK PIN.

This was a repair executed on board a small steamer, carrying 100 nominal horsepower engines, running on a time charter up and down the West African coast. It was before the days of built-up crank shafts.

When at sea, a flaw was noticed in the fillet of the low-pressure crank pin, which though slight at first developed very rapidly, necessitating a very careful repair, or stoppage of the ship would have been necessary. The flaw extended over about one-third of the circumference of the after fillet and underneath the pin, "crank on top," as shown at *B* in Fig. 3. In the writer's experience, defects in crank shafts, whether solid or built up, usually occur at this point, and are mainly attributable to the faulty position of the thrust block. Instead of the thrust being taken up by the shaft bearing, the thrust block has to be adjusted, and a nip is thrown on the crank pin at the point *B* in Fig. 3, which usually results in a loose pin in a built-up crank shaft, or a flaw, as in this case, in a solid one. As the runs between the ports were not long the engines were kept running, but were well watched, while the engineers thought out the difficult problem of repair and got the necessary appliances ready.

The repair was effected by fitting a pin through the crank, as shown at *A* in Fig. 3, a spare main-bearing bolt with collar and nut, shown in Fig. 2, being employed for the purpose. Drills and ratchets were got already before the engine was stopped, and drilling was commenced from each end, a $1\frac{3}{8}$-inch hole being drilled through both webs and crank pin, the holes meeting in the center. Colored labor being plentiful on the coast the holes were got out in good time.

After the holes were drilled the complete hole was bored by means of the arrangement shown in Fig. 4. A boring bar *E* was fitted with a pilot end *H* screwed into the boring bar, to save forging down and to keep the bar true. The slot for the cutting tool was arranged, as shown at *F* in Fig. 5, so that the body of the bar *E* took up the weight of the cutting. Another slot was cut at *G* in the boring bar, and a larger cutting tool was placed in it, which came into operation after the cutter *F*.

Fig. 4 shows the arrangement of the boring bar. The plates *D D* were used to support it, with the distance pieces *C C* long bolts, as shown, holding the whole thing together, and keeping the bar and the boring central with the pin. The hole was recessed at each end to receive the collar and nut, as shown in Fig. 3, and the nut was cut down for the recess.

When the boring was finished the crank was well warmed by means of a wood fire, the bolt tapped in with an anvil slung in ropes for the purpose, the bolt end outside of the collar being left on until the bolt was right in its place. The nut was then put on, hardened up, and the bolt end riveted over it. The ship completed her charter, and ran home with the repaired shaft. A new shaft had been sent out, but it was not necessary to use it.

JOHN McCALLUM.

A Curious Deposit on the Inside of a Marine Boiler.

A very curious experience, which occurred on board a vessel running between the Indian ports and New York, may be of interest to other engineers, as showing the peculiar and unexpected troubles which sometimes give the mariner engineer and opportunity of deep thinking. After making one of these voyages the boilers were opened out for inspection and cleaning, and when the engineers got inside they were very much astonished to find the whole surface inside the boilers covered with a fine powder, which had the exact appearance of ordinary black lead. In spite of a lot of worry on the part of the staff no possible explanation of this trouble could at the time be thought of, but in order to prevent any further trouble of this description the men were put into the boilers, and the whole surface was scraped and cleaned as thoroughly as possible. When this had been done about half a ton of soda was put into each boiler, which was then filled with pure, fresh water; the fires were then lit, steam raised, and about 20 pounds pressure maintained on the boilers, the water being meanwhile kept in constant circulation by means of the independent feed pumps for a period of about twenty-four hours. The boilers were then allowed to stand and cool for two or three days before pumping them out, and when this had been done, and the boilers were opened out again, it was found that the black deposit had all been boiled off. The boilers were then washed clean and filled up again with fresh water, and the vessel got ready for the run of twenty-eight days.

The boat had not been long out to sea, however, before excitement began to be the order of the day, one after another the boiler tubes began to burst, and nearly every day it was necessary to put in either one or two new tubes. On one day the number rose to six. When the vessel reached port again the boilers were all opened out again, and a further trouble was discovered. The interior of the boilers was covered with red rust, or what is commonly known as bleeding, and all the scale that had been on had been cracked right away.

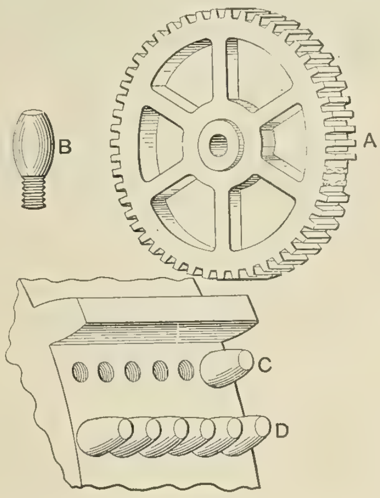
It was no easy matter to restore the boilers to their normal condition, and in order to get a thin scale on the boilers again it was necessary to use a very large quantity of lime, which was fed in with the feed water. After nearly twelve months this course of treatment secured a good scale on the boiler surfaces, and as soon as this was obtained the trouble ceased.

There is no definite solution to the mystery of the cause of formation of the original black deposit, but the only conclusion that can be arrived at is, that while the vessel was loading manganese ore the ship had been on the mud of the river, and a lot of the finer particles of the ore had, during previous repeated loadings, fallen into the water and settled on the bottom of the river. In this way a good deal of this ore was pumped into the boilers along with the feed water while the vessel was loading, and this had deposited and caked upon the internal surfaces of the boilers.

H. S. Emerson.

A Barring Gear Breakdown.

It occasionally happens that owing to carelessness in putting the barring gear into mesh with the main engine, one or two of the teeth of the barring pinion get broken, as shown at *A* in the sketch. The first step in such an accident is to chip and file away the broken surface until it is level with the main portion of the rim in the casting. When this is the case a number of holes are drilled and tapped in the rim along the center line formerly occupied by each of the teeth which are to be repaired. Nearly every boat of any size has on board a small lathe, and it is then possible to turn from a rod of mild steel a series of studs similar to that shown at *B*. The contour of these studs should correspond accurately to the cross section of the tooth, and across the top of the stud when finished should be placed a saw-cut, to provide a hold for a screwdriver adjustment fixed to an ordinary brace. The shank of the stud should be screwed so as to form a fairly hard fit into the stud holes, and by the aid of the brace the stud should be tightened into position, as shown at *C* and *D*. After the studs are turned into the shape of the teeth very little dressing is required after they have been placed in position, in order to allow the pinion to run smoothly in gear with



SUBSTITUTION OF PINS FOR TEETH IN A BROKEN GEAR.

the engine, and if they are made of mild steel their tenacity and strength is nearly equal to that of the original cast teeth, and thus this forms a very good repair.

It will be seen that the only drawback to this arrangement is, that instead of a continuous bearing surface being presented to the engaging teeth, the wear takes place on a series of small curved surfaces, and the wear is therefore unduly great. Where plenty of time is available, or where the wheel can be sent off the ship, it is advisable to leave the surface of the studs rough, and to bring the teeth to shape after they have been put into position, either by means of chipping and filing, which in the case of a large wheel is rather a tedious matter, or if the job can be done on shore, to place the wheel in a shaping machine and take a series of cuts along the line of the studs, so working them to shape. Machinist.

Twin-Screw Yacht Miranda.

The largest steam yacht which has been built on the south coast of England was built at the Southampton works of Messrs. John I. Thornycroft & Company, Ltd., last summer, for Lord Leith of Fyvie; the contract for the hull and machinery being sublet to Messrs. Thornycroft by Messrs. Camper & Nicholsons, Ltd.

The vessel, which is called the *Miranda,* is built of steel, and was designed by Mr. Charles Nicholson, of Gosport. She is 220 feet in length over all, and 190 feet on the waterline. The breadth is 31 feet 10½ inches, and the contract 14 knots on a draft of 13 feet. The Thames yacht measurement is about 1,000 tons.

The machinery, also built by Messrs. Thornycroft, consists of two sets of triple-expansion surface-condensing engines, with cylinders 14½ inches, 23½ inches and 38 inches diameter by 24-inch stroke. The boiler installation comprises two boilers of the single-ended return type, working at a pressure of 180 pounds per square inch.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Shipbuilding in the United States.

According to the annual report of the Commissioner of Navigation, the total tonnage of shipping constructed in the United States for the fiscal year ending June 30, 1909, was the smallest since 1898. The construction for 1908, which comprised 1,457 vessels, aggregating 614,216 gross tons, was the largest ever constructed. The decline, therefore, to 1,247 vessels of only 238,090 gross tons in 1909 is very marked, and indicates that shipbuilding during the past year has been practically at a standstill as compared with previous years. This sharp decline was, of course, not unexpected, on account of the general business depression throughout the world. Other countries suffered in this respect as well as the United States, for shipbuilding in the United Kingdom dropped from 1,580,000 tons in the calendar year 1907 to 914,000 tons in 1908.

Of the total tonnage constructed, 582 ships, aggregating 108,904 gross tons, were built on the Atlantic and Gulf coasts, while 174 ships, aggregating 100,402 gross tons, were built on the Great Lakes. One hundred and forty-one sailing vessels, with a total gross tonnage of 28,950, were constructed during the year, and 821 steamships, with a total gross tonnage of 148,208. No large vessels were built for ocean-going service during the year; in fact, only 31 vessels of over 1,000 gross tons were built, and these comprised only about 50 percent of the total tonnage. The largest of these was the Clyde liner *Mohawk,* of 4,623 gross tons, built at Philadelphia. This shows that the large shipyards on the coast were practically without merchant work during the year, and without naval work they would have been in severe straits. The only type of construction which reached anywhere near an encouraging figure was that included by steel ferryboats, steam dredges and river and bay steamers, all other forms showing a marked decrease, the most noticeable decrease being, of course, that of ocean steel steamers.

During the past few months shipbuilding has revived somewhat, and it is estimated that both in the United States and abroad the tonnage built during the current fiscal year will approach approximately the normal output. Encouraging as this appears, it should not be forgotten that the normal output of the shipyards on the Atlantic and Pacific coasts of the United States is ridiculously low as compared with that of the yards of other countries of similar importance. Nor is this condition of affairs likely to be bettered until steps are taken by the government toward the upbuilding of the American merchant marine in the foreign trade. As long as the deep-sea tonnage is neglected the shipping and shipbuilding industries cannot possibly provide the resources demanded by the naval strength and commercial importance of the nation.

Performance of the Battleship Delaware.

Last month we published a description of the battleships *Delaware* and *North Dakota,* and gave fairly complete details of the official trials of the *North Dakota.* Since then figures covering the trial performance of the *Delaware* have come to hand, and it is interesting to compare them with the results obtained with the *North Dakota.*

On the four-hour full-speed trial the speed of the *Delaware* was 21.563 knots; the indicated horsepower, 28,578; the coal consumption, 24.5 tons per hour; the steam consumption of the main engines per indicated horsepower per hour, 13.12 pounds, and the steam consumption for all purposes per indicated horsepower per hour, 14.56 pounds. On the twenty-four-hour trial at

19 knots the average speed was 19.225 knots; the indicated horsepower, 23,600; the steam consumption per indicated horsepower per hour of the main engines, 13.05 pounds, and the steam consumption per indicated horsepower per hour for all purposes, 14.5 pounds. For the full-power trial of the *North Dakota* the steam consumption of the main turbines per shaft-horsepower per hour was 13.6 pounds, and for all purposes, 13.96 pounds. On this trial, however, the *North Dakota* reached a somewhat higher speed than the *Delaware,* her average speed being 21.64 knots. For the twenty-four-hour trial at 19 knots her steam consumption per shaft-horsepower per hour for the main engines was 14.11 pounds, and for all purposes, 15.29 pounds.

It is, of course, impossible to draw any exact conclusions from this comparison, since we are dealing in one case with the indicated horsepower of reciprocating engines and in the other with shaft horsepower of turbines. More complete details of the trials will undoubtedly be made public by the Navy Department in the future; meanwhile, it is safe to conclude that the Navy Department is satisfied with the performance of turbine engines for battleships, since they are being adopted in all new construction.

Naval Reorganization.

Important reforms in the administration of the Navy Department have been inaugurated by the new Secretary of the Navy. These reforms affect first, the organization of the Navy Department itself; second, the administration of navy yards.

The changes in the organization of the Navy Department have been designed to overcome the defects of the old organization due to the lack of a branch dealing directly with the military use of the fleet and the lack of responsible expert advisers to aid the Secretary in reaching conclusions in case of disagreement between the co-ordinate branches of the department. On account of the growth of the navy and the increasing amount of business, the different bureau chiefs have been necessarily engrossed in the details of their own duties and, with the complexity and conflicting interests involved in the creation and maintenance of a modern fleet, they have at times failed to agree on matters where the field of each has overlapped. As the business of the department has grown beyond the personal co-ordinating power of the Secretary, it is necessary for him to have assistants in the different divisions to present matters of business for his verbal decision or for his signature. To effect the principal changes found necessary, it is intended to abolish the Bureau of Equipment and distribute its duties among the other bureaus. The other bureaus are continued in full effect. To fill the position of advisers to the Secretary the department has decided to detail four officers who are of recognized ability and specially fitted by experience in their particular fields, and who will be, so far as practicable, flag officers. These aids will have no supervisory or executive power or authority, and will act solely in an advisory capacity.

The reorganization in the administration of work at navy yards is in the nature of the extension and modification of the reforms inaugurated by the previous Secretary of the Navy. The principle underlying these previous reforms was consolidation, and this is to be carried out as far as possible under the present scheme of administration. The original consolidation scheme left the commandants of navy yards nominally in full control, but really without much supervision over the manager, who was the naval constructor. It created one pay-roll for the manufacturing department and put all labor under the manager. It also put the care of buildings and grounds and all civil engineering work under the manager. The direct and beneficial effect was to move machines and tools to more useful locations and reduce the number of shops employed for manufacturing and repair. The disadvantage, however, lay in the fact that the function of the officers in other bureaus than that of construction and repair was reduced nominally to that of inspectors. Thus, the equipment, ordnance and engineer officers, who were for the most part men of from twenty-five to thirty-five years' experience, were replaced by young assistants of comparatively few years' theoretical training, and, generally speaking, of little practical experience. It also deprived line officers of that practical shop and navy yard experience which they need to be able to maintain the vessels of the fleet in good condition without too frequent recourse to navy yards, and it placed upon the managers in most instances more work than they could properly be expected to perform. In the reorganization of the work the machinery and hull divisions are separated and the machinery division placed under the charge of the engineer officer. This division is logical, and follows the almost universal practice in the management of similar classes of work in manufacturing and repair establishments, and it also accords absolutely with the systems in successful operation in most private shipbuilding concerns and in the naval dockyards of England and Germany. The management of navy yards is again placed in the hands of the commandant or captain, and it is the intention that these officers shall be carefully selected and specially qualified by previous training and experience, and that the length of time which they hold office shall be sufficient to give them the opportunity to produce a continuous and efficient administration.

Doubtless for a time the management of the yards will not be as smooth or as efficient as it formerly was, since no new system can be inaugurated and worked out perfectly at the first trial. The principles underlying the reorganization are, however, excellent, and the changes should in the end prove beneficial.

Progress of Naval Vessels.

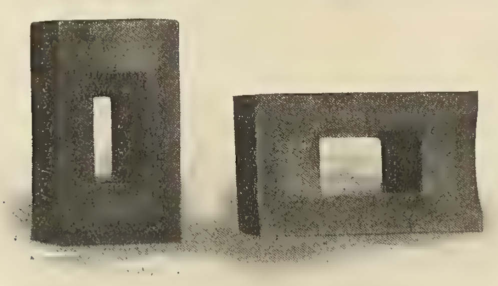
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Nov. 1.	Dec. 1.
BATTLESHIPS.					
Delaware ...	20,000	21	Newp't News Shipbuilding Co.	97.4	98.0
North Dakota	20,000	21	Fore River Shipbuilding Co..	96.6	97.5
Florida	20,000	20¾	Navy Yord, New York.......	38.3	42.3
Utah	20,000	20¾	New York Shipbuilding Co..	50.0	54.3
Arkansas ...	26,000	20½	New York Shipbuilding Co..	1.0	3.2
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	0.0	1.7
TORPEDO-BOAT DESTROYERS.					
Smith	700	28	Wm. Cramp & Sons.........	99.4	100.0
Lamson	700	28	Wm. Cramp & Sons.........	92.8	94.8
Preston	700	28	New York Shipbuilding Co..	95.9	99.7
Paulding ...	742	29½	Bath Iron Works............	46.1	53.5
Drayton	742	29½	Bath Iron Works............	37.0	46.8
Roe	742	29½	Newp't News Shipbuilding Co.	66.4	68.8
Terry	742	29½	Newp't News Shipbuilding Co.	65.8	68.4
Perkins	742	29½	Fore River Shipbuilding Co..	59.3	64.0
Sterrett	742	29½	Fore River Shipbuilding Co..	58.1	62.6
McCall	742	29½	New York Shipbuilding Co..	34.2	37.5
Burrows	742	29½	New York Shipbuilding Co..	34.2	37.5
Warrington..	742	29½	Wm. Cramp & Sons..........	53.0	55.6
Mayrant	742	29½	Wm. Cramp & Sons..........	54.6	56.5
Monaghan ..	...	..	Newp't News Shipbuilding Co.	3.2	4.7
Trippe	...	..	Bath Iron Works...........	7.9	11.8
Walke	...	..	Fore River Shipbuilding Co..	5.2	7.9
Ammen	...	..	Fore River Shipbuilding Co..	8.2	10.4
Patterson ...	...	..	Wm. Cramp & Sons..........	3.4	5.1
SUBMARINE TORPEDO BOATS.					
Snapper	...	..	Fore River Shipbuilding Co..	99.3	99.3
Salmon	...	..	Fore River Shipbuilding Co..	87.0	87.2
Seal	...	..	Newp't News Shipbuilding Co.	28.2	30.8
Carp	...	..	Union Iron Works..........	16.0	27.4
Barracuda ..	...	..	Union Iron Works..........	16.1	27.5
Pickerel	...	..	The Moran Co..............	13.0	23.1
Skate	...	..	The Moran Co..............	13.1	23.1
Skipjack	...	..	Fore River Shipbuilding Co..	8.4	11.1
Sturgeon ...	...	..	Fore River Shipbuilding Co..	8.4	11.1
Tuna	...	..	Newp't News Shipbuilding Co.	7.7	9.9

ENGINEERING SPECIALTIES.

Vanadium Steel Dies for Hot Forging and Drawing Work.

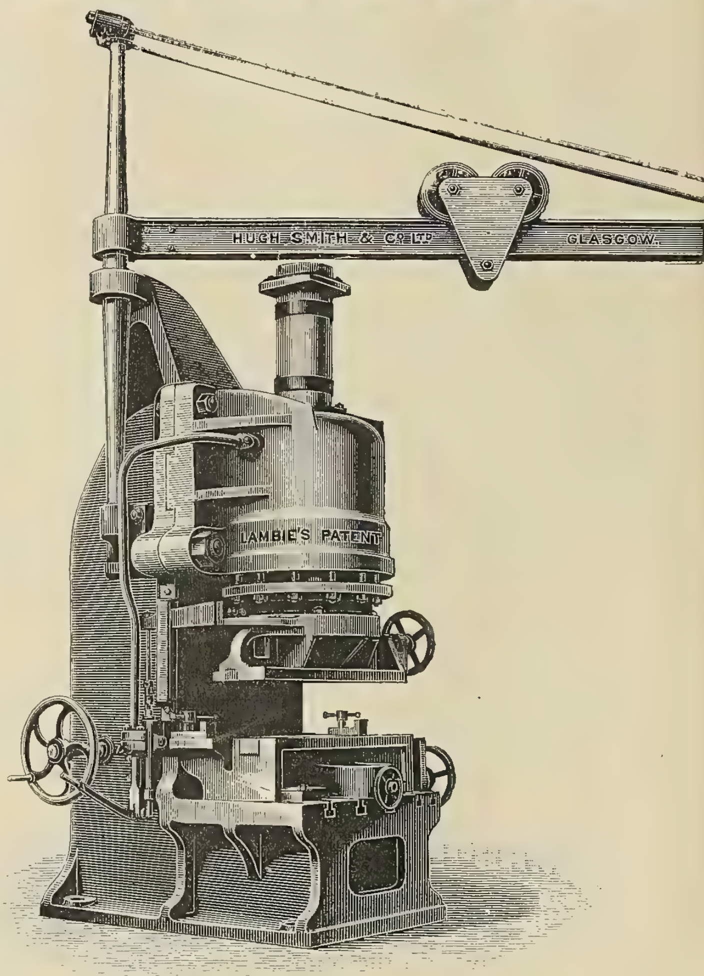
A customer of the Pennsylvania Forge Company, Philadelphia, Pa., was using carbon dies on very severe service for hot forging and drawing work. These dies were giving an average service of two days, and breaking from crystallization and other defects in the steel. They decided to try vanadium steel in the hope that the remarkable properties of



vanadium in retarding or eliminating crystallization would give the dies a longer period of usefulness; some vanadium steel was purchased from the Bethlehem Steel Company, and the dies shown in the illustration were made therefrom. We have been advised by the Pennsylvania Forge Company that the dies were used in the same manner, by the same man, on the same machine and for the same service as the carbon dies, and at the time of writing us had been in use for over four months; the illustration is made from a photograph of the dies at the time the letter was written.

"Lambie's" Patent Hydraulic Joggling Machine.

The illustration shows "Lambie's" patent combined hydraulic angle-bar and plate-joggling machine, manufactured by Hugh Smith & Company, Ltd., Possil Engine Works, Glasgow, for joggling angle-bars or bulb angles, as used in ships' frames, and also for joggling ships' deck plates to obviate the use of packing slips or liners. The machine is suitable for joggling the angles, bulb angles, or plates, without alteration or changing of dies. The die blocks are fitted with patent wedge arrangements for adjusting, so as to give the amount of joggle, either to the plates or angles, as may be required,

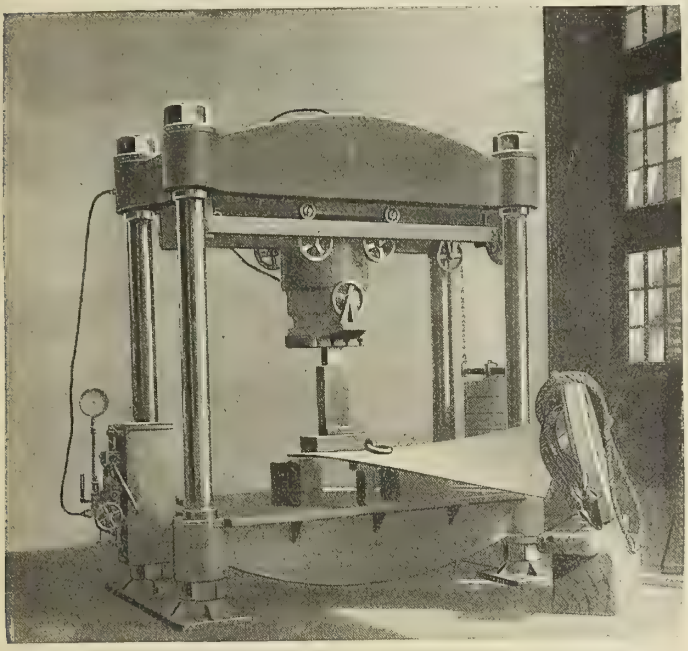


the die blocks being indicated and marked for the guidance of the workman. The cylinders and rams are made of suitable size to suit the water pressure available. The machine can also be adapted for punching manholes, or used for flanging plates and beveling angles. The saving in weight of hull effected by working on this system is claimed to be about 10 tons per 1,000 tons dead-weight capacity of vessel, which adds to the carrying capacity of the vessel. A considerable saving in workmanship is also effected.

Straightening Propeller Blades by Hydraulic Power.

Straightening propeller blades, which have become bent through contact with some solid object, is rather a trying job, because, usually, the force of the impact in a collision curls the metal up to something the shape of a wood shaving. The practice in straightening out such curves has been to block the bent part of the blade into a yoke with two stationary bearing points on the bottom platen, and apply a powerful pressure on top between these points by means of a hydraulic jack inverted from the upper platen of the yoke. If enough pressure could not be secured in this way, the blade was blocked with one stationary bearing underneath, and two hydraulic jacks on top, one on either side, forced the blade back to proper shape.

In the Brooklyn navy yard two 100-ton hydraulic jacks were used in this way, but the power was hardly sufficient for straightening the larger blades. To meet the demand for greater power, the straightening press shown in the illustration



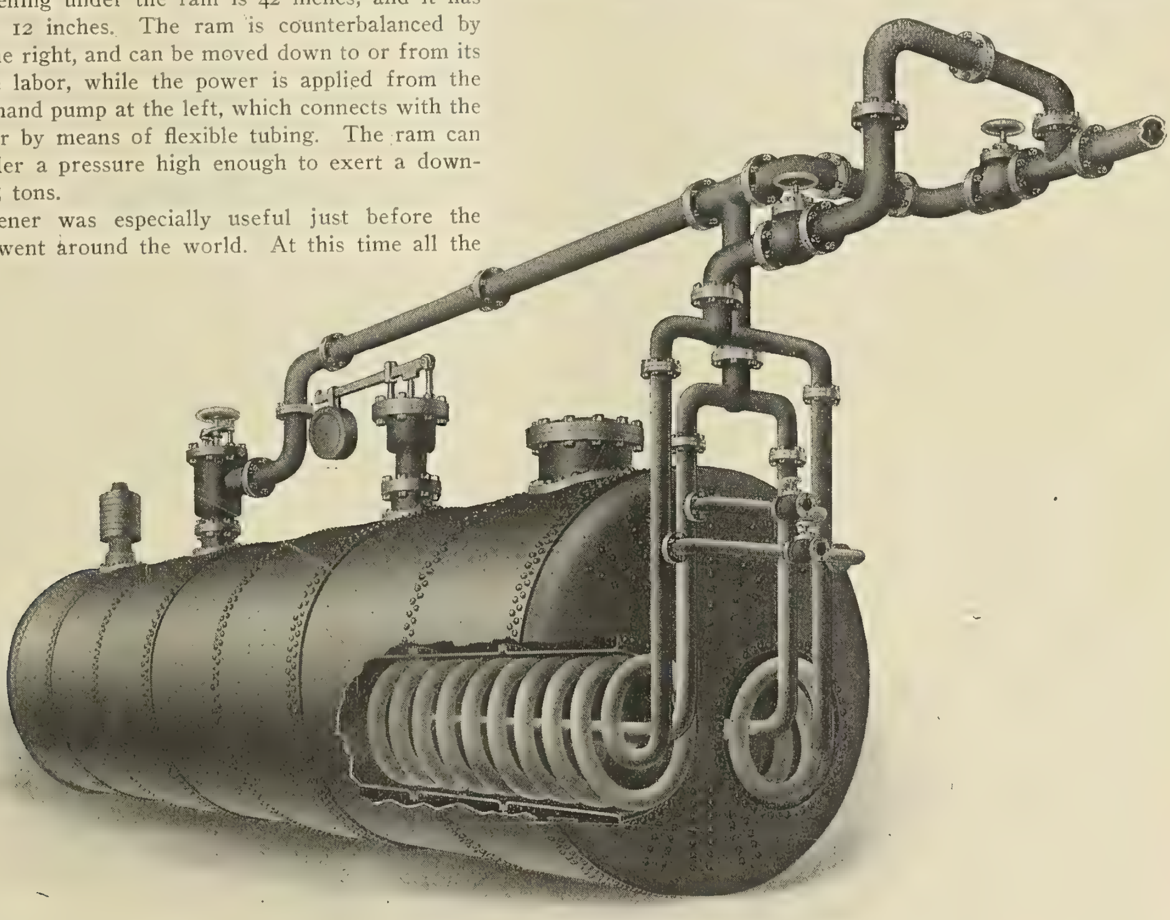
was designed and built by the Watson-Stillman Company, of New York. The platens are each 54 inches by 84 inches. The ram cylinder is mounted on a truck, which travels 2 feet either way from the center on tracks just below the upper platen. The vertical opening under the ram is 42 inches, and it has a movement of 12 inches. The ram is counterbalanced by the weights at the right, and can be moved down to or from its work with little labor, while the power is applied from the double-plunger hand pump at the left, which connects with the pressure cylinder by means of flexible tubing. The ram can be operated under a pressure high enough to exert a downward force of 5 tons.

This straightener was especially useful just before the American fleet went around the world. At this time all the bent propellers were replaced by new ones, and the bent blades were straightened. These were placed on board their respective ships and kept as spares in case of accident in a foreign port. The delay and expense thus prevented more than paid for the straighening press. This machine has frequently proven useful in shaft straightening, having enough power to bend a 14-inch shaft, cold, on bearings 6½ feet apart. In one instance a 16-inch propeller shaft was so badly bent at the beginning of the taper that the outer end where the blades were fastened was ¾ inch off center. This shaft was bent back into good alinement, where otherwise it would have been a loss.

As a general utility tool the machine is also used for such work as putting tires on the yard locomotive wheels, forcing pistons and cross-heads onto piston rods, putting in and taking out bushings, making compression tests, forcing steel spiders onto wrought pipe, in building large piston valves, etc. A hole 12 inches in diameter in the lower platen facilitates forcing work vertically.

The Steamcubator.

The Steamcubator, manufactured by the Steamcubator Engineering Company, London W. C., is an apparatus designed for attachment to boilers to protect the ordinary or saturated steam, developing it to the highest degree of quality and efficiency to which it is theoretically or practically possible for steam to attain. The water of saturation which the steam contains when leaving the boiler proper retards its velocity and conducts to rapid condensation, but when passed through the Steamcubator it is generated into active live steam of high temperature, thus producing not only a larger yield of true steam, but enormously increasing the velocity and expansive force of the whole. The absolute minimum tendency



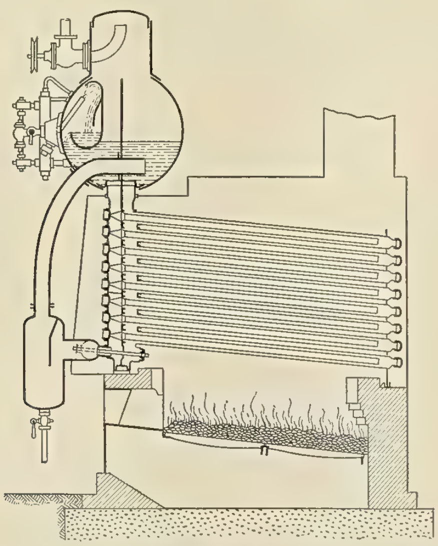
to condensation is secured. The Steamcubator, by reason of the fixing of the helix in the flue tubes of Lancashire, Cornish, and marine boilers, imparts to the gases a rifled or spiral motion, which increases their velocity, thereby aiding combustion by accelerated draft.

The deleterious effect of steam superheated by ordinary superheating apparatus is caused, not by the temperature to which the steam is raised, but by the method of attaining this temperature. This method results in part of the steam being decomposed into its original elements of oxygen and hydrogen. The free oxygen at once attacks and combines with the iron or steel with which it comes in contact, forming the neutral salt, oxide of iron, while the free hydrogen gas destroys, by volatilization or carbonization, the lubricating agents in the steam cylinders, and causes scoring and reeding. In the Steamcubator the steam is treated in substantial bulk or volume, and only gradually raised to a high temperature, retaining its original proportion of oxygen.

A fuel saving of 30 to 40 percent is claimed for this apparatus, and it is also claimed that the steaming capacity of boilers is increased by 50 percent.

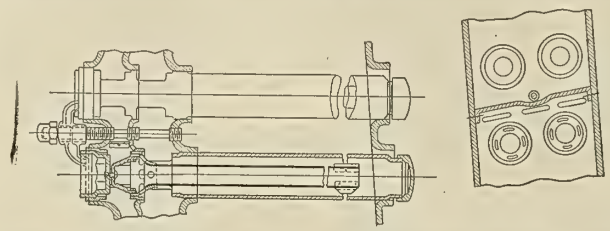
Improvements in the Niclausse Boiler.

Details have just been made public of important improvements in the Niclausse marine watertube boiler manufactured by J. & A. Niclausse, Paris, France. During the last two years it has been the policy of the manufacturers to eliminate all cast iron from the construction of the boilers, replacing it



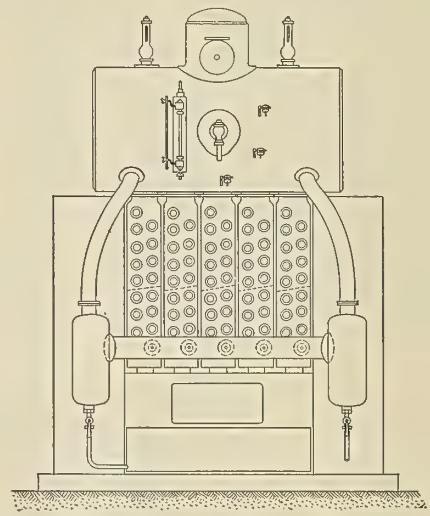
with steel. The headers, which formerly were made of malleable iron, now consist of rectangular steel tubes, which are formed without welding, and in which are flanged by means of powerful pressure the cones which receive the tubes. Also the lanterns, instead of being made separately, are cut from the tubes themselves. Improvements in the furnace include compressed air jets, which have been installed under the grates in order to secure better combustion and to avoid a reignation of the gases in the stack. A new arrangement has also been provided, by means of which the tubes can be cleaned without interrupting the generation of steam or lowering the pressure, but the most important improvement and the one which the manufacturers are having patented has for its object the bringing into the lower row of tubes; that is, those which are exposed to the highest temperatures, water which has been heated to a high temperature and cleansed of all the impurities which it originally contained.

This result has been secured by dividing the headers into two parts by means of a diaphragm, as is shown in the illustrations. The rows of tubes are also divided into two sections—the upper and the lower. The feed water enters directly, as in the old type of boiler, into the upper nest of tubes, where it is heated to a high temperature and deposits whatever impuirities it contains in these tubes, where no harm is done, since the tubes are not exposed directly to the flames. After the water has been heated and purified, it reascends to the steam drum and by means of two down-comers is led to the lower nest of tubes. Two baffles placed in the lower part of the down-comers prevent any impurities which might still



remain in the feed water from entering the lower tubes, where the evaporation is very rapid.

It is claimed that this method of circulating the water in the boiler elimminates the distortion and burning of tubes due to overheating, since there is no opportunity for deposits to form on the inner surfaces of the tubes. The principal claims made for the new arrangement are greater safety, increased circulation, less frequent cleaning, reduction in the expense of maintenance, and elimination of the necessity of replacing tubes.

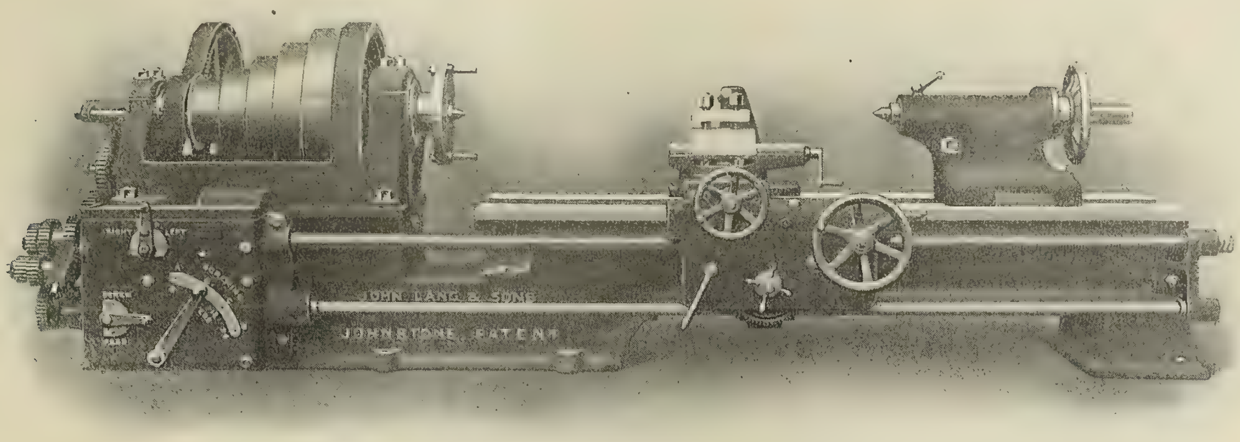


Experimental Tank Apparatus.

An important part of the work carried on by Kelso & Co., Glasgow, in addition to the building of ships' models as described on page 420 of our October, 1909, issue, is the construction of apparatus and equipment for experimental model towing tanks. This firm has built the entire equipment for nearly every important experimental model towing basin in existence, with the exception of that at Washington, D. C.

Sliding, Surfacing and Screw-Cutting Lathe.

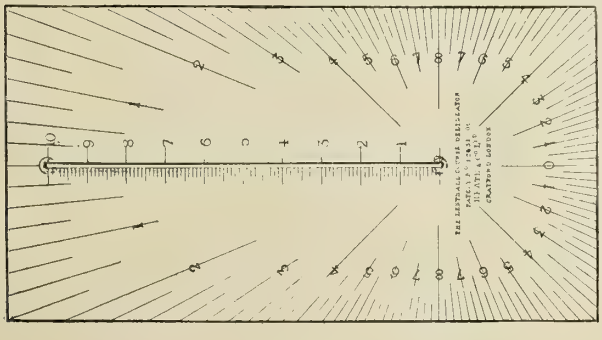
John Lang & Sons, lathe manufacturers, Johnstone, have placed on the market a lathe involving their latest developments in sliding, surfacing and screw cutting; the lathe being built for great power and rigidity, to allow engineers to obtain the advantages of high-speed steel. The bed, which is of Lang patent type, is 28 inches wide on the face and 25⅝ inches wide on the body. It can swing at gap 55 inches clear



of the screw and bed. The distance from the front face plate to the front of the gap is 17 inches. The lathe will admit 7 feet 5 inches between centers when the bed is 15 feet long. Standard feeds given by Lang's handle-feed motion are 1/6, 1/12, 1/18 and 1/24 inch in advance of the tool per revolution of spindle. Due to the patent screw cutting and feed motions it is impossible to have the screw and shaft revolving at one time; it is impossible to put the surfacing and sliding feeds into action at one time. Either the screw or shaft can be started or stopped or reversed while the lathe is running. There are four feeds both for sliding and surfacing, which may be changed while the the lathe is running; four screws of different pitches may be cut, any one of which may be had without stopping the lathe. These may be altered by changing gears, every alteration allowing of four different pitches being cut while the feeds for surfacing and sliding remain constant, and are not affected by the alteration of change gears. The approximate floor space required by the machine is 16 feet 7 inches by 7 feet, and the total finished weight is 162 cwt.

Lenthall's Patent Delineator.

The illustration shows an instrument useful to all in charge of vessels, and particularly to yachtsmen, fishermen and masters of coasters or other small vessels. With it it is claimed that all problems in dead reckoning navigation can be accurately solved without the use of books, tables or any other instruments. The instrument is made of transparent celluloid and is radially divided from a central point, *A*, into points, half points and quarter points of the compass, or, if desired, into degrees. A slit just wide enough to take the point of a pencil is cut from the central point, *A*, to a point near the outer edge of the instrument. The slit is marked with a scale divided into ten equal parts, and each division is again subdivided into ten equal parts. The divisions on the scale are numbered consecutively from 1 to 10, commencing with the first division from the central point of the instrument. The radial lines indicating the points of the compass are numbered consecutively from 1 to 8 and 8 to 0 on either side of the slit. In the case of the instrument divided into degrees the radial lines indicating every 10 degrees are numbered consecutively in tens from 10 to 90 and 90 to 0 on either side of the slit. In using the instrument it is advisable to work the problems out on special paper that is ruled with vertical parallel lines. This useful and novel instrument is manufactured by Heath & Company, Ltd., Crayford, London.



SULZER DIESEL MARINE ENGINE.

BY P. JACOBY.

Liquid fuels long held a secondary position among fuels used for the production of mechanical energy, due partly to the limited supply and partly to the lack of proper means for using them economically. Contrary to the general impression, now, however, the output of the world's oil fields is extensive, amounting to over 35,000,000 tons in 1907, and steadily increasing since then. The supply, therefore, is no longer such an obstacle to the use of liquid fuel as it formerly was. The means for its utilization in the production of energy have also been improved; one of the most characteristic agencies for this being the Diesel internal combustion engine.

It is only recently, however, that the Diesel engine has been adapted to marine work, since in order for any internal combustion engine of large power to be useful for marine work it must be reversible. The question of direct reversal in the Diesel engine has been carefully workd out by Messrs. Sulzer Brothers, Winterthur, Switzerland, and in 1906 a direct reversible Sulzer Diesel marine engine was produced.

The engine (Fig. 1) is single acting and works on the two-stroke principle as follows:

On the upward stroke of the piston, as in the four-stroke cycle, the compression of the air in the cylinder is affected to such a degree that the heat produced is sufficient to spontaneously ignite the fuel on the introduction of the latter into the cylinder. During the downward stroke of the piston the fuel is admitted in the form of a spray and is gradually burnt as it enters the cylinder. On completion of the expansion, large ports in the wall of the cylinder are uncovered by the piston, the scavenging air valves in the cylinder cover are then opened and the expanded combustion

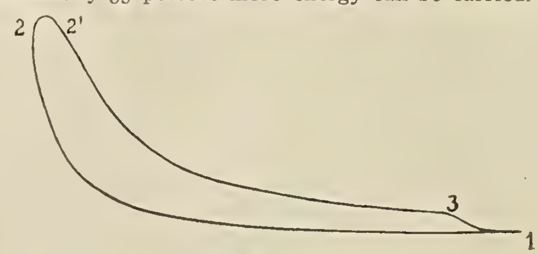
gases expelled by means of the scavenging air pump. The accompanying indicator diagram (Fig. 2) shows the method of working.

First stroke, compression and heating of air (curve1-2).

Second stroke, (working stroke) combustion (2-2′); expansion (2′-3); exhaust of combustion gases and introduction of pure air (3-1).

The engine is usually made with four cylinders, which not only insures a perfectly uniform turning moment, but enables the engine to be started with certainty, irrespective of the position of the crank. Besides the working cylinders the engine is supplied with an air pump for the highly compressed air for starting, reversing, and the injection of the fuel, and further, with a low-pressure scavenging air pump. Important accessories to the engine are the three steel vessels for the reception of the compressed air (for starting and injection purposes). The engine is of the enclosed type, but the various parts, such as cranks, bearings, pistons, etc., are readily accessible by means of removable doors.

from the fact that about 1,000,000 British thermal units of crude oil only require a space of 1 cubic foot, while 1,000,000 British thermal units of good hard coal would require about 1.35 cubic feet. With similar storage capacities, therefore, approximately 35 percent more energy can be carried. It is



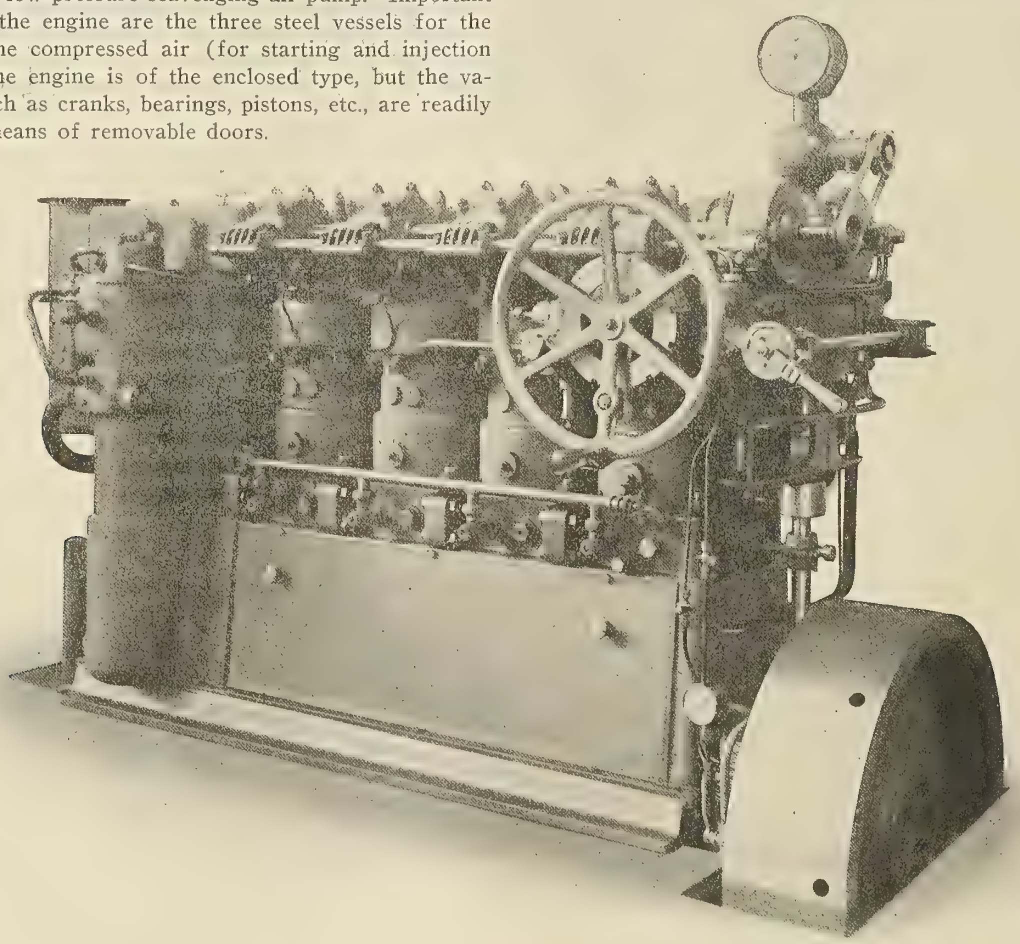


Fig. 1.

Fig. 2.

It is claimed that the engine can be reversed in a few seconds. When starting, the hand wheel, shown on the right of the engine in the illustration, is turned and admits compressed air into the cylinders. A further movement of the wheel puts the starting valve out of gear, at the same time opening the fuel valve so that the engine starts working. In the reverse manner the engine is stopped and reversed. The starting valves and fuel valves are operated by oscillating eccentric cams, the motion of which is determined by the motion of the reversing shaft according to the direction of the engine whether running or at rest.

The fuel, consisting of mineral oil residues (Mazout) and the cheap by- and intermediate products of oil refineries and gasworks, is easily stored in the double bottoms of ships and in the ballast tanks. It can be readily taken on board, either by means of pump and hose or by means of compressed air, so that no difficulty is experienced in transferring liquid fuel even on the high seas. In proportion to its high heating value, crude oil has a remarkably small bulk, as may be gathered claimed that the Sulzer Diesel two-stroke engine consumes only about ½ pound of fuel per brake-horsepower-hour; consequently the radius of action of a ship thus equipped should be considerably greater than if provided with a steam plant.

General interest will be awakened by the results which have been obtained with a 150-horsepower engine recently supplied to the Steamship Company in Zurich. The company in question having a steamer which was useless for regular service on account of its slow speed determined to have it fitted with a more powerful engine. The speed of this particular steamer was hardly 8¾ miles per hour, whereas the present timetable demanded a speed of 11¼ miles per hour at least. The displacement remaining unaltered, this increase of about 30 percent in speed would have meant an increase of two and a half times in the output of the engine. The new plant was to fit into the space of the old one, and the weight was not to exceed the weight of the old plant. The working expenses, however, were to be cut down as much as possible. It was not difficult to foresee that the substitution of a

new steam plant for the old one would not have answered the purpose with any degree of certainty.

Preliminary investigations of this plant soon indicated that the conditions laid down, both as regards speed as well as economy, could be fulfilled by a Diesel engine. The Diesel engine was accordingly fitted in the early part of this year, and the steamer has done regular daily service since the end of July; the results of the trials exceeding all expectations, inasmuch as a speed of over 12 miles per hour is obtainable, while it is claimed the cost of fuel has been reduced to one-fourth. Compared with the old steam plant the output of the engine has been doubled. The amount of fuel carried is sufficient for the steamer to travel ten times the distance hitherto possible, and this at an increased rate of speed; at the same time a saving in weight of 35 percent results.

The trial trips, which were carried out by the steamship company, took place on Sept. 30, 1909. The trial course measured exactly 24 kilometres (14.9 miles). The fuel consumption was regulated by a decimal weighing apparatus, and it may be mentioned that the measurement of fuel as compared with that of coal is almost mathematically exact. The fuel used was Galician petroleum, the present price of which in Zurich is about 48/- ($11.50) per ton.

At a speed of 12½ miles per hour, the cost of fuel was 1½d. (3 cents) per mile; the cost of fuel per brake-horsepower-hour under similar conditions being 139d. ($2.78). The further working costs will also be considerably less than with the steam plant, as there is no boiler to maintain with its attendant expenses for cleaning, repairs and attention, and the engine room staff is reduced.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

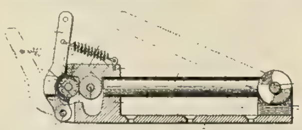
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

928,579. BOAT. ADOLPH E. APEL, OF ATLANTIC CITY, N. J.
Claim 2.—A motor boat consisting of a hull having a bow curved under and provided with a bottom compartment having side keels tapering in depth to nothing at the stern and the bottom of the boat between the side keels being made substantially flat transversely where the keels are deep and gradually curved upward in a transverse or athwartship direction adjacent to and at the stern and the highest point of such transverse curvature being at the transverse center of the boat, combined with means for delivering air into the compartment near the bow and forming a film of air between the bottom of the boat and the water, and whereby it leaves the bottom centrally of the boat at the stern. Two claims.

929,057. EXHAUST FOR MOTOR BOATS. JULIUS WM. WALTERS, OF GLENS FALLS, N. Y.
Claim 2.—A submerged exhaust outlet for motor boats provided with means responsive to movement of the vehicle to automatically control the direction of flow of the exhaust. Fourteen claims.

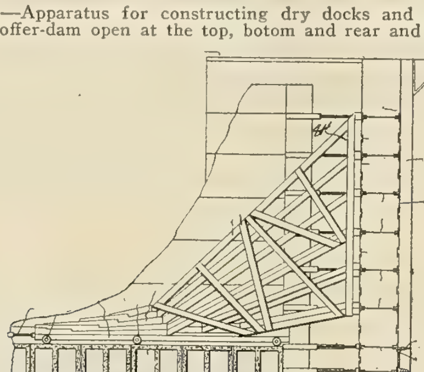
929,993. COAL-HANDLING APPARATUS. ALFRED CHAMBERS STEWART, OF READING, MASS., ASSIGNOR OF ONE-FOURTH TO AUSTIN H. ROBY, OF MALDEN, MASS., ONE-FOURTH TO CHARLES H. CUTTER, OF SOMERVILLE, MASS., AND ONE-FOURTH TO CHRISTIAN P. ANDERSEN, OF BOSTON, MASS.
Claim 1.—A coal handling apparatus comprising a hull, a fixed track composed of rails extending lengthwise of the hull, and elevated above the same, said rails being separated by an unobstructed space, a carrier adapted to run on said track and extending downwardly between the rails into said space, a movable track frame extending crosswise of the fixed track below the latter, and movable on the carrier crosswise of the hull, and a car movable on the said track frame. Seven claims.

931,122. RELEASING DEVICE. CHARLES HUNT, OF NEW YORK, N. Y., ASSIGNOR OF ONE-FOURTH TO JASON ROGERS, OF ESSEX FELLS, N. J.
Claim 1.—A boat provided at the ends with releasing devices, each comprising a frame attached to the boat, an arm pivoted on the frame



and adapted to receive a member of the boat-lowering device, a block pivoted on the frame, and engaging the free end of said arm, a lever for locking the block, and a spring connecting the end of said lever with the said block. Nine claims.

931,182. DRY-DOCK. LEONARD M. COX, OF BROOKLYN, N. Y.
Claim 1.—Apparatus for constructing dry docks and the like, comprising a coffer-dam open at the top, botom and rear and having hollow



front and side walls, power mechanism disposed between the dam and the work for advancing the dam, and means for maintaining water-tight joints between the side walls of the dam and finished portions of the dock. Twenty-four claims.

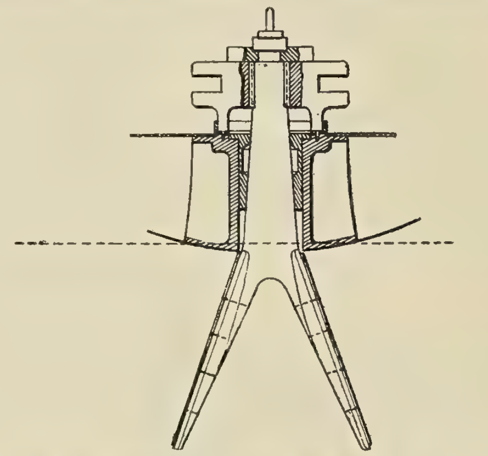
932,722. BALLAST TANK FOR SHIPS. GEORGE SIMPSON, OF QUINCY, MASS., ASSIGNOR TO FORE RIVER SHIP BUILDING COMPANY, A CORPORATION OF MASSACHUSETTS.
Claim 1.—A ballast tank for ships, located near the top of the cargo space of the ship and within the hull and having its inner wall which is exposed in said cargo space smooth and obstructionless, said wall being

hung from the hatch combing, and provided with a framing all of which is located wholly in the interior of the tank, said framing including braces fixed to said wall and adapted to be connected with the framing of the ship. Three claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 4 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

122. SRIPS' RUDDERS. J. WHITE & CO., LTD., OF EAST COWES, ISLE OF WIGHT, AND PETER HASTIE, OF THE SAME PLACE.

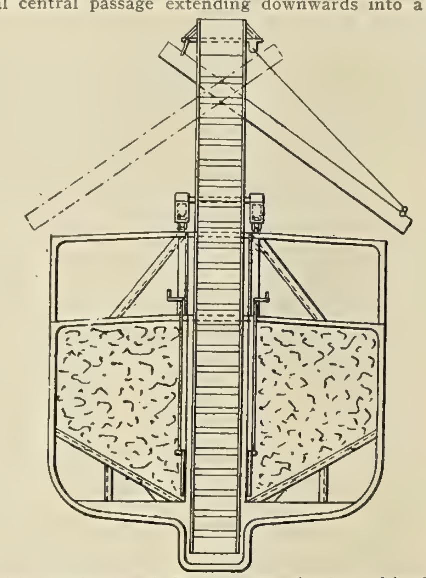
This invention has for its object to obviate the necessity for carrying helm to counteract the effect of the propeller race when running on a



straight course, and consists in forming the rudder with two flat or curved blades diverging downwardly from the stock and situating it relatively to the screw propeller in such a manner as to be above the zone of the water acted on thereby. For high-speed boats and for evenly distributing the effective pressure of the water over the whole of areas of the two blades they are provided with apertures.

861. CONSTRUCTION OF SHIPS OR LIGHTERS TO FACILITATE DISCHARGE OF CARGO IN BULK. G. E. HOLLAND, OF BRYN-Y-MOR, HOLYHEAD, ANGLESEY.

A ship or lighter for carrying cargo in bulk is constructed with a longitudinal central passage extending downwards into a box keel and



provided with openings and doors communicating with the hull of the vessel for the discharge of the cargo into such passage. Elevating apparatus is accommodated in the passage and mounted on a truck on rails supported on stanchions on each side of the passage.

5,581. POWER GAS PLANT FOR USE ON BOARD SHIP. T. H. OSWALD AND T. H. OSWALD, JR., BOTH OF LONDON, E. C.

According to this invention, the heat carried off from the engine cylinder or cylinders by the cooling water circulating through the cylinder jackets, as well as the waste heat of the gases exhausting from these cylinders, is utilized for the purpose of evaporating sea water and converting the same into fresh water for use in the process of generating suction or power gas.

19,586. PROPELLERS FOR SHIPS AND THE LIKE. C. FOX AND M. S. HOBBS, BOTH OF BOURNEMOUTH, HANTS.

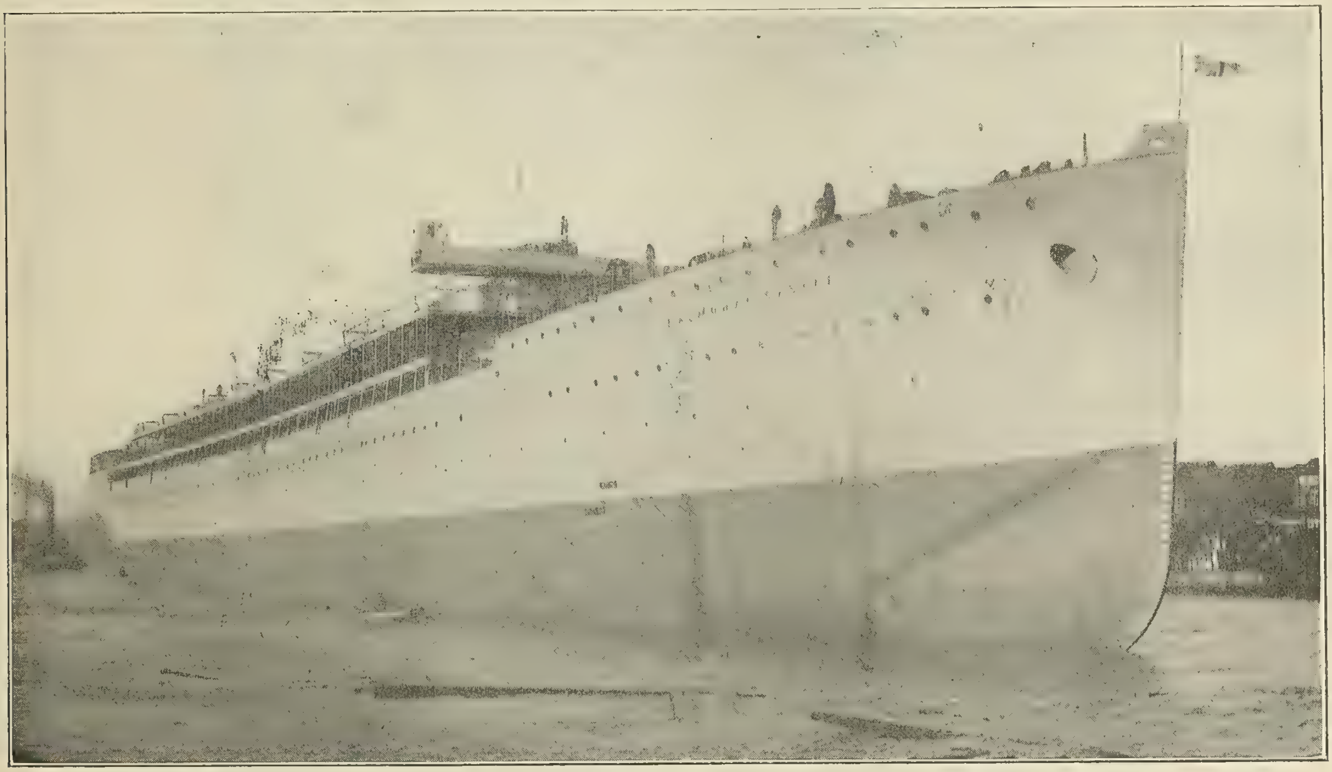
According to this invention, the pitch of the screw is made less than, or at any rate not greater than the diameter of the blade. It is, however, not constant throughout its length and the leading part has preferably an increased pitch as compared with the rest. At the leading edge the blade is preferably made almost straight. Proceeding backward along the blade from this edge and along the side which presses against the water in forward driving, the face of the blade is made to gradually assume a concave form, the concavity being either greatest above the center part of the screw or even greatest at the rear end. The blade is attached to a straight piece of tubing, the diameter of this tubing being small, so that there is practically no boss to impede the action of the propeller.

International Marine Engineering

FEBRUARY, 1910.

THE NEW CASTLE LINER BALMORAL CASTLE.

The Union-Castle Mail Steamship Company's new liner, *Balmoral Castle,* of 13,000 tons gross, was constructed at the Govan shipyard of the Fairfield Shipbuilding & Engineering Company, Glasgow, and was launched on Nov. 13, 1909. The new steamer is fitted with quadruple-expansion riciprocating engines, which drive two propellers, and she has been built to the rules of Lloyd's Register for the highest classification of that society. Her principal particulars may be given for clearness in tabulated form as follows:



THE NEW 13,000-TON UNION-CASTLE MAIL LINER, BUILT BY THE FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY.

Length over all	590 ft. 9 ins.
Length between perpendiculars	570 ft.
Breadth, extreme	64 ft. 6½ ins.
Depth, molded	42 ft. 6 ins.
Mean service draft	26 ft.
Mean service displacement	17,500
Indicated horsepower	12,500
Speed at sea	17 knots.
Tonnage, gross	13,000
Number of first class passengers	320
Number of second class passengers	220
Number of third class passengers	270

The hull is divided into separate watertight compartments by nine bulkheads. To further insure immunity from danger, a double bottom is fitted all fore and aft, divided by watertight floors into separate water-ballast tanks. Each tank can be filled or emptied independently, so that the trim and draft of the ship can be adjusted at any time to suit the conditions of service.

The propelling machinery of the *Balmoral Castle* consists of two sets of quadruple-expansion engines of the latest type. These engines embody all the latest improvements, including balancing on the Schlick-Tweedy principle. Special attention has been paid to this feature in the design, the position of the cylinders and the crank angles being arranged so as to ensure that vibration will be practically non-existent. The dimensions of the cylinders are as follows: High-pressure cylinder 32 inches diameter, second intermediate-pressure cylinder 66½ inches diameter, low-pressure cylinder 96 inches diameter, the first intermediate-pressure cylinder 46 inches in diameter; they are placed in the order named, reading from forward to aft. The stroke common to all cylinders is 60 inches. The valves admitting steam to the high-pressure and first mean-pressure cylinders are of the piston type, while those to the second mean-pressure and the low-pressure cylinders are the ordinary flat slide valves. The valve gear is of the usual link-motion type, controlled by a double-cylinder "all-round" type reversing engine.

The crankshafts are of the built-up type, and are 19 inches diameter in the journals. The crankshaft for each engine is in four separate sections, and is carried in eight bearings in the bedplate, the bearings being lined with white metal. The whole of the shafting is of solid ingot steel.

The condensers are of the ordinary type, and are supported on brackets attached to the back columns of the main engines. The total condensing surface for both engines is 17,000 square feet. The condensed water is discharged from these into a hot-well tank at a temperature of about 100 degrees F.

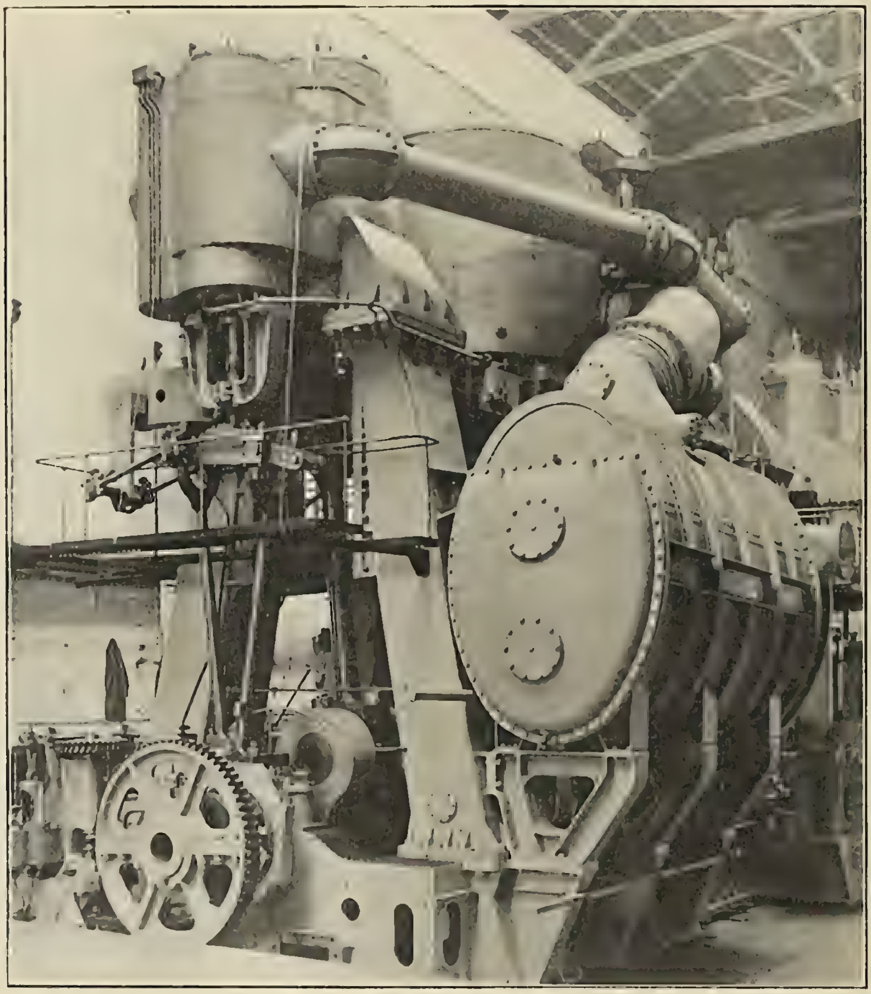
There are two propellers, each having four blades of manganese bronze, bolted to cast steel bosses.

The boilers, ten in number, six of which are double ended and four single ended, are arranged in two groups in separate boiler rooms. The double-ended boilers have each six furnaces, and the single-ended boilers have each four furnaces, making a total of fifty-two furnaces. The products of combustion are led into two funnels of oval form. The furnaces are of the corrugated type. The total heating surface is 40,780 square feet, and the working pressure 220 pounds per square inch. All the furnaces are worked under natural draft, but fans have been provided for ventilating the stokeholds.

The auxiliary machinery, in the way of pumps, filters, heaters, evaporators, etc., is of a very complete and up-to-date character. There are four Weir's boiler-feed pumps, arranged in pairs. Each pair is controlled by a Weir float-control tank, having a cross-connecting pipe, so that any pump can be controlled by either control tank. These pumps draw from hot wells through two independent sets of List & Mun's patent filters, and discharge through a Quiggins heater, or direct to boilers, as required. There is also in each boiler room one of Weir's auxiliary feed pumps, having the same connections as the main pumps and controlled by each float tank. These are for feeding the boilers while in port. The main circulating pumps are of the *Bon Accord* centrifugal type, by Messrs. Drysdale & Company, Glasgow, and of ample size to ensure an efficient vacuum under all conditions. These circulate the water through the main condensers, the outlet water being discharged below the light-load line. Each circulating pump is arranged to draw from the engine-room bilge through separate valves, each 18 inches diameter, in the event of a serious leak taking place in the ship.

The ballast pump is of Messrs. H. Watson & Company's Westminster type; the pump barrel, bucket, valve boxes, etc., are of gunmetal. The pump is connected to the bilge main, the engine-room bilge direct, and to the ballast tanks, and discharges overboard through the port main condenser or through the distilling condensers. There are three vertical duplex pumps, made by Messrs. J. H. Carruthers & Company, for general service, for supplying salt water, for fire service, for sanitary service, and for hot and cold salt-water baths, of which there is a large number on board, the water for hot baths being discharged through a large tank, which is heated by steam coils. These pumps are arranged to work independently of each other, so that they can be used at the same time on separate services.

The evaporator plant consists of two Quiggins evaporators, each of 40 tons capacity per twenty-four hours; two Quiggins distillers and filters, each of 6,000 gallons per twenty-four hours; one vertical pump for feeding evaporators, and one pump for brining evaporators. The evaporators are connected to the main condensers for making up feed water, and to the distillers for making drinking water.



ONE OF THE QUADRUPLE-EXPANSION ENGINES OF THE BALMORAL CASTLE.

The auxiliary condensing plant for use in port is capable of dealing with the exhaust steam from all the auxiliary machinery. It consists of a condenser, a centrifugal pumping engine and one of Lamont's patent double-bucket air pumps, with one steam cylinder. The water from the auxiliary condenser drains to a collecting tank, and then overflows to the feed filter and feed pump. There is one vertical duplex steam pump of Messrs. Carruthers' make, drawing from fresh-water tanks in the double bottom and discharging into service tanks on deck for ship's use. This pump is controlled by a separate float tank.

At the forward end of the shaft tunnels there is an enclosed steam engine driving a fan, which draws fresh air through a trunk from the top deck for ventilating the tunnels.

In each boiler room there is a boiler-circulating and ash-ejector pump, of the vertical duplex type, made by Messrs. Carruthers. There are two See's ash ejectors, one in each boiler room. Two ash hoists and engines are fitted for raising ashes while the ship is lying in port.

The electric generating plant consists of three sets, manufactured by Messrs. Allen, of Bedford. Each set embodies a compound-wound dynamo, directly coupled to a high-speed engine, and is constructed for a continuous output of 75 kilowatts at 100 volts when running at a speed of 265 revolutions per minute. The engines are of the vertical, enclosed, double-acting two-crank type. Each has one high-pressure cylinder, 9 inches diameter, and one low-pressure cylinder, 15 inches diameter, the stroke being 9 inches.

The steam steering machinery is Messrs. Brown Bros.' patent tiller gear, with emergency gear alongside, both of these being controlled from the forward or after bridge by telemotor gear. The rudder head is 15 inches diameter, and the rudder is of the single-plate type, having a horizontal coupling. The thickness of the rudder plate is 25/20 inch. Two powerful warping capstans are fitted alongside the steering house aft on the promenade deck.

The *Balmoral Castle* has six decks, named in the following order from below: Orlop, lower, main, upper, promenade and boat deck. The ship has two oval funnels and two pole masts, with seven derricks for working cargo.

On the promenade deck, amidships, is the first class entrance and lounge. In the center of this room there is a large well over the first class dining saloon. The lounge is handsomely furnished with small tables, easy chairs and settees, also a grand piano. At the aft end of the lounge is the first class library. Forward of the lounge there is a house containing a number of first-cabin staterooms. On the promenade deck 'midships there are several second-saloon staterooms, also the Doctor's and purser's rooms. Aft of these rooms there is the second class entrance, which leads to the second class library. The promenade deck aft is reserved for third class passengers, and here is placed the third class entrance and lounge and third class smoke room.

Below the promenade deck, and on the upper deck leading from the main entrance, there is the first class dining saloon. This room, which is placed about midway between the funnels, does not extend to the ship's side, but is enclosed in a very broad deck house. In the center of the room there are two long tables, and on each side six small tables. The saloon is arranged to seat 182 persons, and it is well lit by the large dome in the center. At the fore end of the room there is a piano and an organ, and at the after end an artistic sideboard. Forward of the dining saloon there are first class staterooms. Aft of this saloon are the pantries, with the sculleries, galleys, bakeries, confectionery, etc., forming one large kitchen, and equipped with all the most up-to-date machinery and appliances for cooking.

Aft of the pantries is situated the second class dining saloon. In the center are the usual long tables, and at the sides a number of tables, each to seat ten persons. Dining accommodation is provided for 162 passengers. At the aft end of the room there is a piano, and at the forward end and artistic sideboard. This saloon, like the first class saloon, does not extend to the ship's side, and is placed at the aft end of the steel deck house.

On the upper deck aft, near the stern, is the third class dining saloon, which extends the full breadth of ship, with a bulkhead at both ends and an entrance in each bulkhead. Seating accommodation is provided for 162 passengers. There is also a pantry and bar near the saloon and a dispensary and hairdresser's shop. Aft of the third class saloon a number of third class cabins are fitted, with lavatories and bathrooms

Leaving the upper deck and going below, the main deck is reached. With the exception of the fore end this deck is all occupied by two and three or four-berth cabins for first, second and third class passengers. There is a large number of bathrooms and lavatories situated in convenient positions throughout the deck.

The lower deck is all cargo space, part of it being insulated for carrying frozen meat. Under the lower deck is the ship's hold. On the boat deck, forward, is the officers' house. Between the funnels the first class smoke-room is placed, and at the aft end of the deck there is the second class smoke-room. A wireless telegraph office is situated abaft the second funnel. On this deck there are sixteen boats, each carried in Welin's quadrant davits.

For working the anchors and cables there is placed on the forecastle deck a very powerful steam windlass, with two capstans made by Napier, of Glasgow, to work 3-inch stud link cables. For working cargo the vessel is equipped with ten powerful horizontal steam winches, having cylinders 7 inches diameter by 12-inch stroke, and fitted with special heavy reversing gear, the lifting capacity being 4 tons each.

MACHINERY AND PIPING ARRANGEMENTS—IV.

BY JOHN M'COLL.

SUCTION AND DISCHARGE SYSTEMS.

When the auxiliaries of a vessel are to be placed along the shipside, care has to be taken in arranging these so that the shipside suction valves and cocks can be put in convenient positions. They should be easily accessible at all time, and if below the floor-plate level should have extended spindles to bring the wheels or handles above the platform.

The suction valve for the main circulating pump is usually placed low down on the turn of the bilge. It should not be placed on the flat of the ship's bottom, as in the event of the ship touching on a sand or mud bank the aperture would probably fill up, rendering the pump useless. Neither should it be placed high upon the ship side, but rather kept well below the light-load line, so that it will be beneath the surface in any condition of trim or kind of weather. In some ships which have to pass over shifting sand banks in their ordinary trade route, an auxiliary inlet valve is fitted above the main for use should the main be in danger of filling up. It may happen that the best, or perhaps the only place, to put the main inlet valve, would be in way of the bilge keel. In that case the keel should be cut if it would tend to hamper the easy inward flow of water, say when the ship was rolling. Fig. 18 shows how the keel may be cut to prevent ropes, or other gear, getting foul of the cut ends.

The main circulating inlet valves are always made screw-lifting; they should be made also in common with other large valves, to offer the minimum resistance when lifted, or open, to the inflow of the water. The valve chests can usually be

reduced in bulk, if attention is given to this point, when they are being designed. It is sometimes an advantage to have the lower part with the grating made separate from the valve chest proper. The area through the grating to the area of the pipe in sea-suction chests varies in different services from 1.5 to 1 up to 2 to 1. In ordinary merchant service the proportion adopted is one and a half times the area of the pipe.

If the vessel is to sail where the aperture may be closed with ice or weeds, a stop valve with a connection to the auxiliary steam system is fitted to the sea side of the valve chest; these valves are from ¾ inch to 1 inch diameter for the larger chests.

The circulating pump has to draw from the bilge. The bilge valve is usually joined for convenience to the sea valve, and as the bilge valve *may* have an important part to play in the emergency for which it is provided, attention should be given to the following points: The handle or wheel should

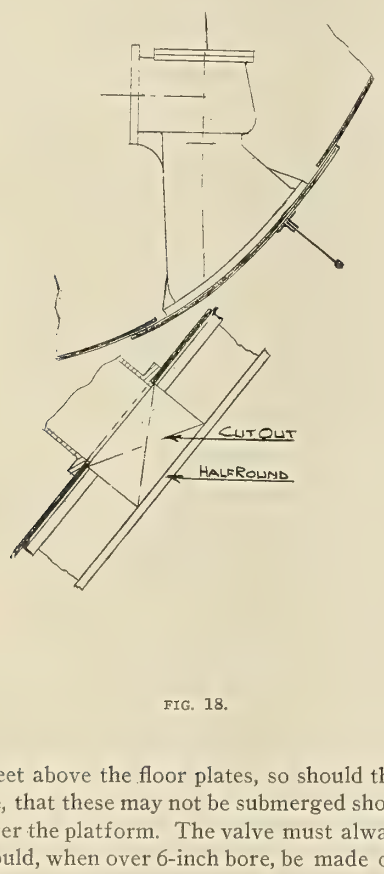


FIG. 18.

be about 3 feet above the floor plates, so should the handle for the sea valve, that these may not be submerged should the water rise to or cover the platform. The valve must always be non-return, and should, when over 6-inch bore, be made of the rubber and guard type, as a brass valve over 6-inch bore has considerable weight, and would be a hindrance to the pump. The pipe from the valve to the bilge should be closed at the end, but perforated with small holes of ample total area, or the end of the pipe may be open, but boxed in with perforated plates. The bore of the bilge pipe is made two-thirds of that from the sea.

If the circulating pump is of the centrifugal type a small air cock with a pipe to the bilge should be fitted to the highest part of the pump casing.

If the smaller pumps are required to have separate sea-suction valves, these may be grouped on one stalk, or grating bore, so that fewer holes need be cut in ship side.

The main circulating overboard discharge valve may be placed above or below the load waterline. In yachts, and in some passenger steamers, the discharge valves are placed below the load waterline, as this prevents the discharged water being flown into spray, and onto the decks, to the discomfort of guests or passengers. All discharge valves may be below the load waterline except that for the air pump, should one be fitted. The usual type of valve for discharge is the L or angle type, non-return, with a cast iron weight on top of the spindle. If the distance between the valve and the deck above it is restricted, the through type of chest may be used, having the spindle and weight on the bottom side of the chest, and leaving just sufficient space below the deck for the valve to be withdrawn from above. As the valves are usually a considerabe height from the platform, means have to be provided for raising and keeping them open; this may be simply done by attaching to the weight a thin wire rope, passing it over a light pulley and down to the platform. If the valves are in an easy accessible recess, some simple device need only be provided for keeping them open. Where cocks are fitted to the ship side for, say, the boiler blow-off to sea, provision is made that the key or handle can be withdrawn only when the cock is closed. But as in the steam and exhaust system, cocks should not be used on the ship side if valves will suit.

When the air pumps are of the independent type, the suction pipe from condenser to pump should be made without pockets or sharp bends, and be as straight or direct as possible. The overflow pipe, on the discharge side, if not led overboard, should be carried high up, and turned down in such a direction as will prevent the overflow water falling into a passage or on men working near.

The feed pumps may draw from the hot well, direct, without requiring spceial arrangements being made, but if there is a graviation filter between hot well and pumps, their respective levels have to be considered. The water should *flow* from the hot well to the filter, and from the filter to the suction valves in the pump. In other words, the suction valves are lower than the filter outlet, and the filter inlet lower than the hot well, and to ensure that the pumps do not draw through the filters, a by-pass is fitted on the filter, that it may be cut out for cleaning or overhaul, if required.

If a float tank is fitted, it is placed as near the center line of the ship as possible to minimize the disturbance due to rolling; and in twin-screw vessels, means should be taken to prevent the water flowing freely across from one pump or filter to the other under the same conditions. The feed pumps should not draw from the bilges, nor should other pumps which may be required to feed the boilers, be connected to the bilge system, if sufficient provision can be made for bilge service otherwise. On the discharge side of the feed pumps the pipes should always be kept above the floor. Where branch pieces are used these should be of Y rather than T-shape. Although cast iron is sometimes used for feed branch pieces, gunmetal is preferred, as being better able to withstand such shocks as they are liable to. They should be strengthened with ribs, and the body of the piece, where it joins the flange, should be gradually thickened up to meet the flange.

On long lengths of discharge piping, provision must be made for expansion, and all bends should be of large radius. They are better carried along the bulkheads and bunkersides, instead of across the front of the boilers, as they can be well supported, and are out of the way of gage glasses, etc. Copper is the material usually employed for feed pipes, but solid-drawn steel is coming into favor for the same reasons as given for their preference in steam systems.

The positions of the check valves on the boilers will depend on the arrangement, but generally they are better to be high up than low down, and on the ends of the boilers than on the sides.

If the filter is on the discharge side of the pump it is required to have an escape valve, and should have a pressure gage fitted between the pump and filter. Both the feed heater and filter should have by-pass valves, to enable them to be overhauled or examined without interrruption to the feed

supply. The auxiliary feed discharge need not pass through the filter or heater, unless specially specified.

In ships carrying a large number of passengers the fresh-water pump and connections are of much importance. It is usual to have some fresh-water tanks in the double bottom reserved for ship and some for engine use. The suction pipes from each tank will probably join into one main, from which the fresh water and feed pumps draw. Herein lies a source of friction between the engine and ship officers, and an arrangement can and should be made that will prevent either department borrowing from the other without the other's consent. On the discharge side of the fresh-water pump it is advisable to have on the overflow a control that will regulate the pump as required. This is sometimes done by fitting close to the pump a small float tank, into which the overflow water is led and from which the water goes back to the tank from which it was drawn.

The ballast pump usually supplies the circulating water for the distillers, and an auxiliary supply to the refrigerating plant. It serves the auxiliary condenser, and in most cases has a connection to the main condenser, for use should the main circulating pump be stopped or go wrong; this discharge should be as large as the pump can supply.

Pipes below or above the platform should be arranged, if at all possible, to lie only fore and aft, or across the ship. Interlacing pipes are a source of trouble when being fitted, and more so when alterations or repairs are required. Beneath the platform the large pipes are better near the tank top, with the smaller pipes above them. Above the platform the steam and exhaust pipes should be placed so that they are not over the passages; this tends to give the engine room an open and cool appearance. It is sometimes convenient to have two or three pipes in the same vertical plane, supported with hangers, as shown in Fig. 19. If, near bulkheads or casings,

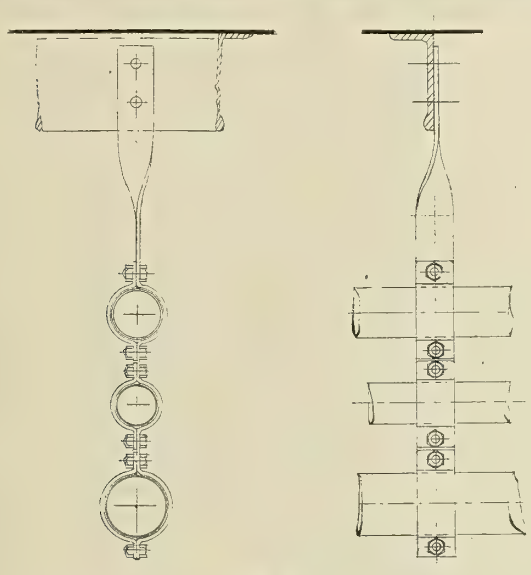


FIG. 19.

pipes should be supported from these, although they may be taken slightly out of their course. Feed discharge pipes especially require to be firmly secured. Light cast iron pipes in straight lengths can be used in discharge services, for ballast and bilge water, for cross connections between circulating pumps in twin-screw engines, and for waste steam leads where these are long; in each case the bends should be of copper. All suction and discharge pipes connected to ship-side valves of cocks should be made of copper, and arranged to take up any slight movement of the ship side without injury to themselves or their connections.

(*To be continued.*)

ORE-HANDLING EQUIPMENTS FOR LAKE VESSELS.*

BY RICHARD B. SHERIDAN.

In a commercial sense the lakes are scarcely fifty years old, and the growth of the traffic has been little short of marvelous. Iron ore, the commodity which has built up the trade more than any other one substance, was first discovered in the Lake Superior country in 1844 by William Burt and his party of surveyors. On August 14, 1855, the first cargo of ore was carried down the lakes from the mining district. This memorable shipment was taken by the brig *Columbia*, and amounted to 114 tons. The entire shipments for the year amounted to 1,449 tons. From this date the trade grew rapidly, but it was not until 1873 that a season's shipment of ore amounted to more than 1,000,000 tons.

DOCKS.

In the development of this traffic, which was destined to become such a factor in our industrial history, the first step taken by its pioneers was the construction of a loading dock at Marquette. This dock was built in 1860, and it is an interesting fact to note that its form of construction has been the model on which all of the great ore docks of the Northwest have been built. A long line of pockets was built on a dock extending out into the lake and arranged so that boats could be brought alongside for loading. The material was brought over the pockets on railway cars arranged so as to be dumped into the same. Each pocket was equipped with spouts and gates, and of such height as to permit of a slope to the chute, so that the material would run out by gravity. Naturally the first dock was of very limited capacity, but the principle has been the one on which all of these loading docks have been constructed.

These structures have been built, up to the present time, of wood, with spouts and gates made of steel plate, the gates being arranged to be opened and closed by hand power. The principle is simple and very expeditious. Records are given in which boats of over 10,000 capacity have been loaded in as short a time as one hour. One of the largest of these loading docks is 2,100 feet long, with 350 pockets, giving a total capacity of 87,500 tons.

The construction of the docks have, in one way, influenced the construction of the lake vessels. The spouts with which each dock was equipped were located 12 feet apart along the dock side, and on account of this dimension the boats built in the early days had their hatches located 24 feet centers so that every other spout would be in a position for discharging into ships' holds without necessitating the shifting of the boat itself. As the boats became larger, and the automatic-grab buckets came into use, the number of the hatches were increased so as to require less hand trimming of the material in the hold of the boat, and to-day we find the ships equipped with hatches spaced 12 feet centers, this distance being determined by the position of the spouts on the loading docks.

The question of loading, important as it has been, has not, however, been the perplexing factor in the development of the lake traffic. The great and all-important difficulty that had to be met and overcome was the question of dispatch in the unloading of boats in the lower lake ports. Forty years ago the boats were not constructed so as to easily take ore cargoes in their holds, and most of the bulk material, such as coal and ore, was carried in deck loads. Where it was carried in the hold, it was hoisted to the deck by horsepower and dumped into barrows and wheeled ashore. In 1867 the

* Abstract of a paper on "Material Handling Equipments for Lake Vessels," read before the Society of Naval Architects and Marine Engineers, New York, November, 1909.

horsepower was done away with, and a small hoisting engine used in its stead. Little progress was made in any way toward improving these early methods, and it was not until the latter part of the seventies that any mechanical schemes were attempted. In 1879 a machine was constructed in the harbor of Cleveland, but it had so many faults that it could hardly have been called a success, and it was not until 1889 that the first successful unloading machine was developed, and this date marks the beginning of the real and speedy development of material-handing machinery, as well as the improvements in the ship construction of the Great Lakes.

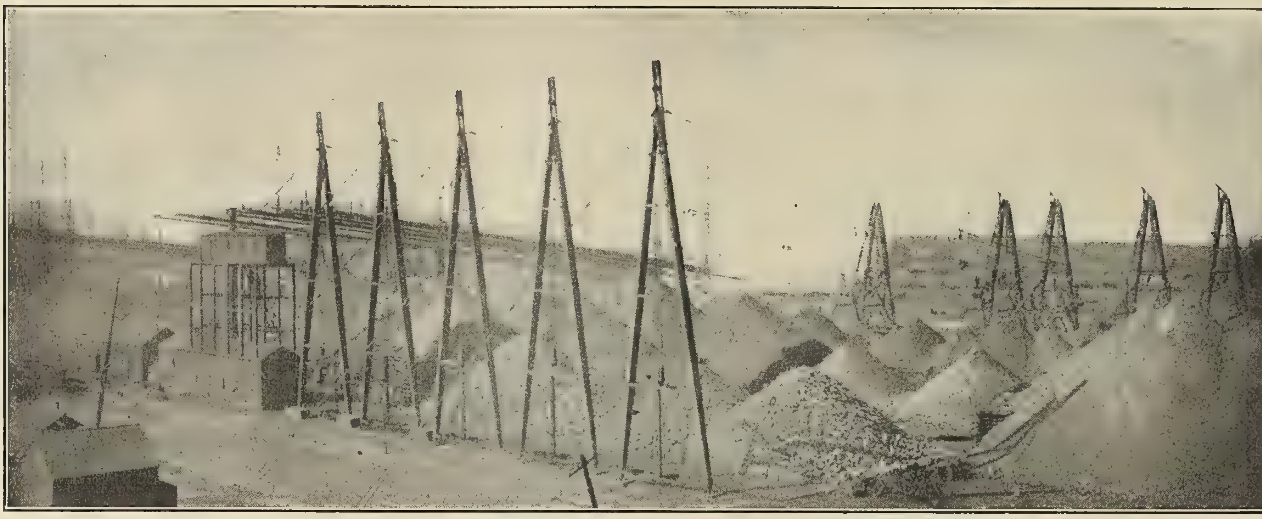


FIG. 1.—BROWN PATENT CABLE TRAMWAY, N. Y., P. & O. R. R., CLEVELAND, OHIO.

FIRST UNLOADING MACHINES.

Many of the various dock managers had been trying every means possible to deposit the ore back from the dock's face by mechanical means. This was first accomplished by a cableway machine, built and erected at Cleveland, Ohio, in 1880, under Mr. Alex. E. Brown's supervision, and with its introduction came the formation of the Brown Hoisting Machinery Company, which has since held such a prominent position among manufacturers.

In Fig. 1 is shown a general view of a plant similar to the first machine erected. Each of the units going to make up the plant of five, consisted of a single rope cable tramway supported by two piers, the one on the dock and the other about 300 feet back from the dock face. The support farthest from the water was A-shape construction and guyed to anchors fixed in the ground. The front support was of special design and mounted on wheels running on two lines of track spaced 24 feet centers.

The front support was arranged on wheels so that the same could be moved a limited distance each side of its normal position, the advantage being to reach every part of the ship's hatch, and also to obviate unnecessary moving of the boat itself. This front pier was arranged to be moved by hand power, and was designed with a portal opening so as to allow railway cars to pass beneath to permit of loading material directly into cars or on to stock pile. This front support was equipped with an arm or apron, which could be housed in a vertical position or lowered down over the boat. The cable was attached to the end of this apron, and when the same was brought to the vertical position, the cable was bent at the hinges and carried on a circular guide, which was concentric with the axis of the hinge of the apron arm. The advantage of this arrangement was that the machine could be operated with the apron in a vertical or horizontal position. On the main cable was designed to run a trolley, arranged to carry a 1-ton ore bucket. The various motions of trolley travel and the raising and lowering of the bucket were controlled through a single drum steam engine, which was located near the rear support.

In Fig. 1 may be seen, at the left-hand side of the five shear-leg supports, the engine house in which were located the five engines controlling the trolleys on the various cableways making up the plant, and the operator for each machine was placed in a small house over the machinery house and at such a height that each operator could easily see and control the trolley on the machine he was operating. The two supports of the cable were of such height as to give a grade in the supporting cable toward the dock face, so that the traveling motion of the trolley when returning empty after discharging a bucket was accomplished by gravity and assisted by a counterweight arrangement acting on the trolley in a direction toward the dock face. By the use of the counterweight, the engine employed was simply a single-drum engine on which was wound a single line. The hoist line of each machine went from the drum on the engine over suitable sheaves to the trolley supporting the bucket, through the trolley, passing down around the hoist block and thence back to the trolley frame, where it was securely fastened.

The buckets were filled by hand in the hold of the boat and then lifted out by the machine and dumped into the storage pile or unloaded directly into cars. The cable was fitted with an up-grade and down-grade stop, the up-grade stop being of such design as to trip the bucket and thereby dump the load. The down-grade stop was simply in the nature of an automatic locking device arranged to hold the trolley still, while the bucket descended into the boat, and when hoisting, to maintain the trolley in the proper position until the bucket was hoisted into the trolley, when automatically the down-grade stop would release, thus allowing the trolley and load to be pulled by the hoisting line up the cable to the dumping stop.

This type of machine was an infinite improvement over the old methods, but it had one fault, and that was, that it could only cover a limited storage pile. The next machines were improved upon, and instead of using the cable type, a structural span bridge of 180 feet in length was employed, and both its supporting piers were mounted on wheels so that the machine could be moved along the full length of the dock.

Fig. 2 gives a general view of a plant of six of these machines. The view is of a plant built of steel throughout, while the first bridges of this type that were constructed were made with many parts of wood. These machines came im-

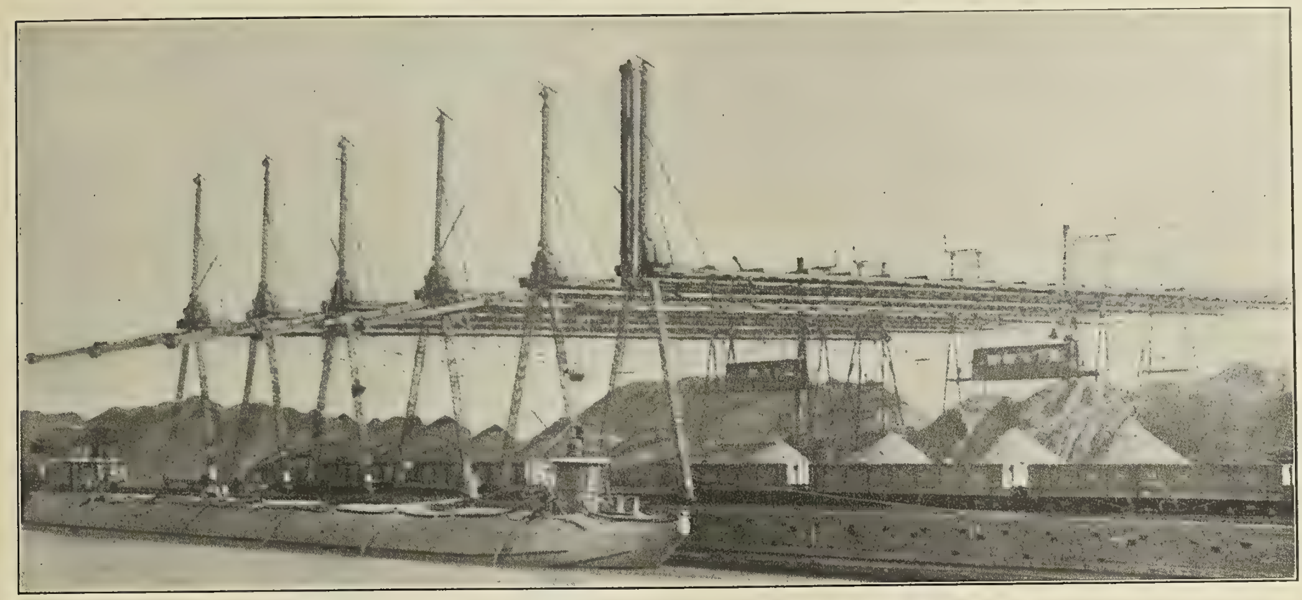


FIG. 2.—TWELVE BRIDGE TRAMWAYS, MENOMINEE DOCK, L. S. & M. S. RY., ASHTABULA, OHIO.

mediately into universal use, and nearly every unloading dock was equipped within a few years. By their use it was possible not only to unload a boat much more rapidly than ever before had been done, but it made it possible to store large quantities of ore. The machines were constructed with a bridge span, and also increased in length by a rear cantilever, so that the ore was stored in two parallel piles, one under the main span, with a capacity of about 220 tons per linear foot, and one under the cantilever projection in the rear with an equal amount per running foot, making a total storage per linear foot along the dock of about 450 tons. The ore was rehandled by the machine out of storage into railway cars.

Although plants of this character proved themselves both time and money-savers, and overcame the great question of handling materials to the stock pile, they did not cut down the cost of filling the buckets in the holds of the boats. This cost varied from year to year, and was largely regulated by the dock labor unions. On an average the filling of the buckets, which was by hand, cost 13 cents per ton, and the cost of handling from boat to dock or stock pile before the time of the unloading machines depended entirely upon how far the ore had to be wheeled, and I am not able to say just how much per ton this averaged. With the introduction of the tramways, however, this work was done for a cost varying from 7/10 cents to 2 cents per gross ton, depending upon how near the machines were worked up to their capacity.

The bridge tramway, as described, came to be an almost universal standard for unloading, but in special cases where cargoes were unloaded directly into railway cars a short plant was often resorted to, and such an equipment is shown in Fig. 3. These equipments were made in batteries of two and four legs. The plant shown is of the two and four-machine unit. All of the operating mechanism was located in one house, and the operators in one cabin, generally situated beneath the machinery house in the manner shown. The main pier, with the machinery and boiler, as well as each of the independent legs, were mounted on wheels, so that they could be moved easily from hatch to hatch along the dock front.

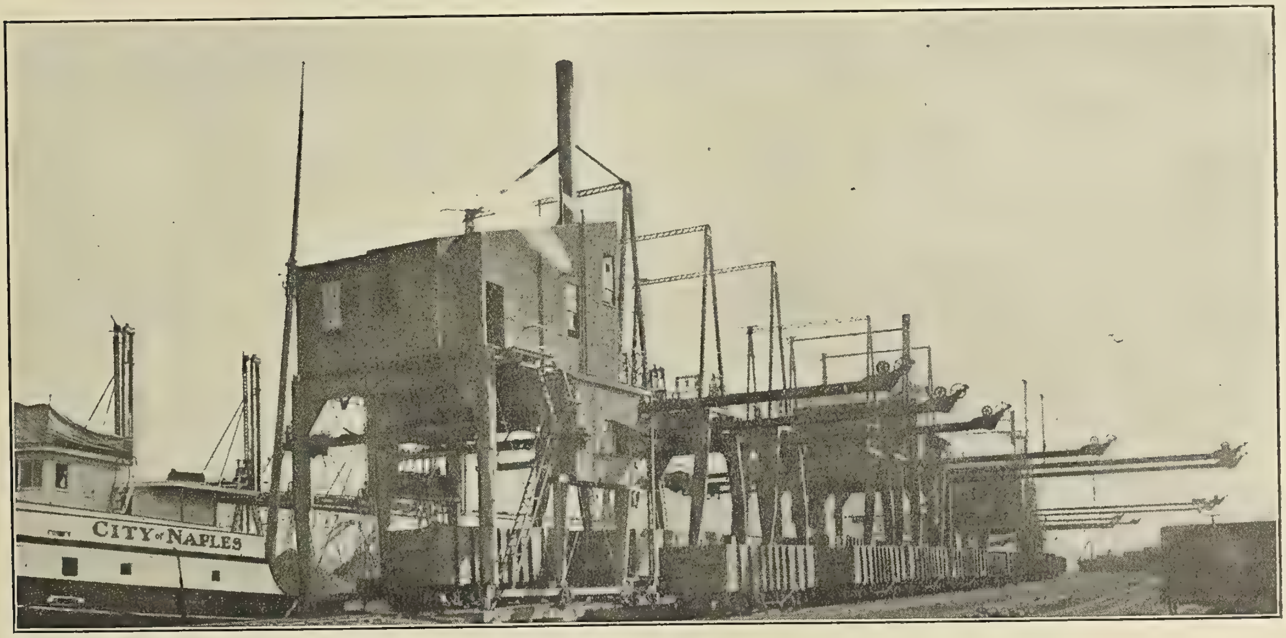


FIG. 3.—TWELVE BROWN HOIST FAST PLANTS, C. & P. DOCK, CLEVELAND, OHIO.

The piers were moved by hand power. The range of working of the farthest independent leg was about 200 feet from the main pier in which the machinery was located.

The machines were made to span two railway tracks and then, by the addition of a rear cantilever, three to four tracks in the rear. These machines, on account of their rapidity, soon received the name of "fast plants," as it was not difficult for them to make from sixty to seventy trips per hour per leg, and this speed was limited largely by the capabilities of the men to fill the buckets.

ADVENT OF THE GRAB BUCKET.

Both equipments, as outlined above, had served a great want and took care of the tonnage in a very satisfactory manner. The problem of reducing the hand labor in the boats became an important factor, and, for several years before the grab bucket was adopted, attempts were made to work mechanical buckets in coal and similar soft materials. They were found to be very efficient tools and were used in different parts, years before finally adopted for ore. In the early days of the ore trade the majority of the ore brought down from the upper lakes was hard and lumpy, and nothing could be done in it with a mechanical bucket. When the soft Messaba ores began to be used, about twelve years ago, the conditions were such as to allow of a mechanical bucket, and renewed efforts were made to develop this class of tool. About nine years ago the first successful grab bucket equipment was erected in Chicago by the Hoover & Mason Company. This plant consisted of four machines, built along the lines of the short fast plants above described and were arranged to discharge directly into railway cars. The main difference between these, however, and those shown on the fast-plant photograph, was that each machine was a complete plant in itself.

The advent of the grab bucket marked a point of radical change, not only in the design of the plants themselves, but also in the design of the boats. Up to the time of using the grab bucket, the material had been handled in tubs of about 1-ton capacity. This size had been found by experiment to be the most satisfactory for hand filling and handling in the hold of the boats, but with the new mechanical buckets the question of size seemed to be limited only by the dimensions of the hatches and the construction of the holds. The first grabs made to handle ore were made to take about 80 cubic feet or 5 tons, and since that time plants have been equipped with 5, 7½, 10 and 15-ton buckets. The question of what the most economical size should be is still a mooted one, and one which no doubt will be discussed for some time.

TYPE OF GRABS.

In the development of the grab buckets, the old principle on which the grabs or clamshells employed for so many years in the handling of dirt and other material have been followed out, and consequently the digging power of the bucket depends to a very large extent upon the weight of the bucket itself, and to get a load it is always conceded that the bucket must be dropped as hard as possible to get an entrance into the material. The buckets have been generally of the two-blade type and with smooth cutting edges. The teeth, which have always been thought necessary, especially in handling lumpy material, have been done away with on account of the injury they did to boats. Furthermore, it has been found more advantageous to have the buckets made with smooth blades, to facilitate cleaning up, which could not be done well with buckets having teeth. The graps employed in this traffic to-day are generally of the two-rope type, and with the exception of the one made by the Brown Hoisting Machinery Company, open and close in about the same manner as those which have been used for the past twenty years, and which, I believe, require no particular mention here.

The design and principle of working of the Brown bucket is novel. On account of the motion of the digging blades on most buckets, weight, as mentioned above, plays a very important part in how good a digger the bucket is, but in the bucket I refer to a new principle is brought into play.

In Fig. 4 will be seen one of the Brown buckets in open conditions. A 5-ton bucket of this make, when open, has a spread of its cutting edges of 14 feet. The blades, when open, stand almost in a vertical position, and when closing, they retain this vertical position for nearly one-half of their stroke, and their action during this time on the material is one of scraping. By the time they have moved through half

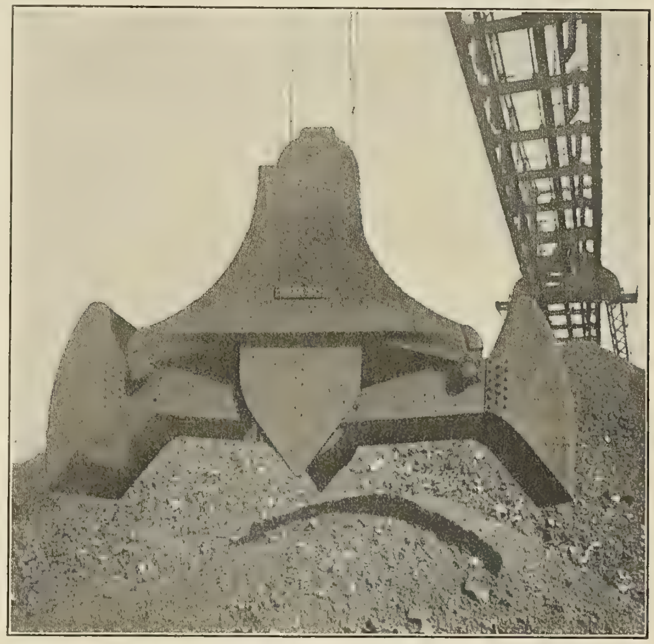


FIG. 4.—GRAB-BUCKET FOR HANDLING COAL.

of their total stroke they have gathered or scraped together a pile of material between them, and at this point the motion of the blades changes to one of rotating, so that they close under the pile of material gathered together. The bucket is so proportioned that the pile which is gathered equals approximately the capacity of the bucket. This grab, also, by its construction is admirably suited for handling lumpy material, inasmuch as the side plates forming the blades of the bucket are cut away at such an angle that the same is past the angle of friction, so that any material getting in front of the edges of these side plates will not cause the bucket to slide over them, but must, by virtue of the angle of these edges, be pushed ahead or to one side. I believe that this feature of the Brown bucket is not found in any other make.

To fill up the gap caused by cutting these edges away as above described, there will be noticed a fixed projection to the shell of the bucket, which when the bucket is closed, closes up the opening between the two spades of the bucket. These buckets will handle in iron ore about the same weight of material as the weight of the bucket.

With the adoption of the grab bucket came still another change in the general design of unloading machinery. The operating machinery on unloaders had, up to this time, always been located in a fixed machinery house, and the action of the machinery was under the control of an operator, located at some fixed point on the machine. With the grab, practically no men were needed in the boat for successful opera-

tion, and the signal men, who had been required when handling the hand-filled tubs, were unnecessary, and consequently it was found more efficient to have the operator travel with the trolley in order that he might see the bucket when in the hold of the boat. To accomplish this, the hoisting and operating mechanism on the machine was all installed on the moving trolley, and this type of trolley has (as it is generally known) become to-day to be recognized as the most efficient and rapid.

Although builders had employed electric power to some extent before the adoption of the man trolley machines, and it had been foun an improvement in many ways over the steam power, the man trolley machines could not be satisfactorily arranged to be operated by any other force than electric, and we might say that the advent of the grab bucket has marked the almost universal use of electricity in unloading machinery, and by its adoption the expense and labor of handling coal, ashes, water, etc., has been saved.

(*To be concluded.*)

MARINE PROPULSION BY ELECTRIC MOTORS.*

BY H. A MAVOR.

At first sight it would appear that on a ship the direct connection between the power generator and the propeller renders unnecessary the use of any intermediate transmission device, and so long as reciprocating steam engines were the best attainable power generators it was possible to correlate the speeds of generator and propeller so as to gain the best efficiency of each. The steam turbine and the non-reversible internal combustion engine introduce a new set of conditions. On land the turbine holds the field for the largest powers, and because its speed of revolution is unsuited to any ordinary mechanical direct application of power for industrial purposes, its evolution has been directly associated with electrical transmission. These turbines are many of them of the same order of magnitude as the turbines used on shipboard, and therefore a comparison of economy in the two conditions is inevitable.

Before the introduction of electric transmission the marine engineer had the more complete scientific data, and consequently the marine engine held the blue ribbon of economy which now belongs to the turbo-electric generator. Among the reasons for the higher efficiency of the land turbines are: That the engineer on land is freer than is the marine engineer to adopt a suitable speed of revolution; that the land turbine runs at approximately constant speed for all loads, and can therefore be run on the governor, rendering easier the application of superheat and augmented vacuum; that on land it is possible to subdivide the power units to meet the conditions of varying load, and thus maintain at the smaller loads an efficiency not materially different from the efficiency at the full load of the system; that at sea, change of power is directly associated with change of speed, and the whole of the power units must always be in motion while the ship is in motion. The same engine has to run the ship at 10 knots and at 20 knots, although the power varies very widely between those limits. Also the high economy on land of power production, associated with electric transmission, is largely due to the possibility of exact measurement of power under all conditions of load, giving a complete knowledge of the effect of all changes in the apparatus or in the methods of working it.

The proposition here made is to provide an electric equipment intermediate between the prime mover and the propeller, extending the limits of practical economy in each by modifying the restrictious which the prime mover and propeller impose upon one another, and providing that the prime mover may operate at or near the constant speed required for the attainment of maximum efficiency and full power, and that the power expended in driving machinery not required for work is reduced to a minimum or entirely eliminated. At full power all the elements of the generating plant are in full operation, and the whole power resources can be concentrated on driving the ship. When full power is not required, the generating plant may be shut down in sections.

To accomplish these ends special motors have been designed, which give the necessary changes of speed and direction and permit of the advantageous combination or elimination of the power generators. These motors involve no new electrical principle, but simply mechanical adaptation of well-known electric designs. Alternating current alone is available for the purpose in question, and normal motors have therefore a fixed speed of rotation, which is a simple multiple of the generator speed.

Two methods of speed change are proposed, each associated with a new form of motor.

The principle of operation of the "Spinner" motor is, that an ordinary normal motor driving the propeller at a fixed speed, with the shaft and propeller directly connected, is so arranged as to be rotatable as a whole about the propeller-shaft axis. This rotation is accomplished by a second motor concentrically arranged outside the first, so that the main motor system may be rotated in either direction—again at a fixed speed, which is a simple multiple of the generator speed—and the speed of rotation of the propeller shaft and of the propeller in the water is the algebraic sum of the rotation of the main motor and the rotation imposed upon it by the auxiliary motor.

As both motors are reversible, it will be seen that in each direction there are three speeds:

1. The speed of the main motor system: the middle speed.
2. The speed of the main motor system minus the speed of the auxiliary motor system: the low speed.
3. The speed of the main motor system plus the speed of the auxiliary motor system: the full speed.

The combination may be designed for any three-speed ratios, such as 1, 2, 3; 2, 3, 4, etc. Any intermediate speeds required are attainable by adjustment of the turbine or engine governor, which can be operated economically through a range down to about 75 percent of full speed. The same method is applicable to non-reversible internal combustion engines.

The "Multiple" motor is an ordinary squirrel-cage induction motor in all respects, except that its stator is wound with two or more independent electric circuits, each associated with a separate source of supply of energy.

For example, the motor may be fed from two sources of supply at 25 and 50 periods, respectively, the motor windings being for 46 and 92 poles. At full power and speed, both windings are in operation under their most advantageous conditions; each of these windings results in a synchronous speed of 66 revolutions per minute. When the 25-period current is supplied to the 92-pole winding the speed is 33 revolutions per minute.

Either of these motors permits of one or more generators being used together in the same mechanical system without electrical connections or synchronizing devices.

The author then goes on to discuss the application of electric propulsion to certain definite types of ship, and also gives diagrams illustrating the saving in space obtained. The examples worked out are as follows:

1. In a cargo vessel of 840 shaft horsepower, the normal reciprocating engine equipment with a single screw would weigh 570 tons for engines, boiler and fuel. The electrical equipment, consisting of three oil engines, three motors and three propellers, would weigh only 270 tons, including fuel. Fur-

* Abstract of a paper read before the Institution of Civil Engineers, December, 1909.

ther, with coal at $4.75 (20s.) per ton, and oil at $9.50 (40s.) per ton, the saving in fuel-cost on a total of $82 (£17) would be $25 (£5 6s.) per day at full power.

2. In a similar cargo vessel gas engines might be used. Taking an equipment of 770 shaft horsepower, and using three gas engines and one multiple motor, the respective weights of the normal and proposed equipments would be 446 tons and 229 tons. The consumption of fuel shows an equally favorable comparison.

3. A third cargo vessel, but of 1,030 shaft horsepower, is worked out for the purpose of illustrating the application of steam turbines to the multiple motor. One plant drives the ship under normal conditions: extra power is supplied by a small turbo-generator, and is used to keep up the ship's speed in heavy or contrary weather.

4. On a passenger vessel of, say, 16,200 shaft horsepower, the electrical equipment permits of a subdivision of the plant, so that at speeds lower than the maximum, only part may be run, and that at full power. This advantage is gained without loss in full-power economy, and without additional complication.

The Possibility of Replacing Magnetic by Rotary Compasses.

BY OUR BERLIN CORRESPONDENT.

The tendency shown by a top, free to move in a horizontal plane, to orientate its axis in a north-south direction, and which would allow it to be used as a "rotary compass," was discovered as far back as 1852 by Léon Foucault. Eneavors have since been made to design an outfit, by means of which this novel compass might be used for practical purposes, without, however, obtaining any affirmative results.

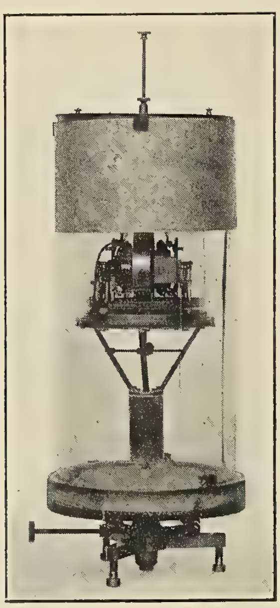


FIG. 1.

In view of the deformations undergone by the field of terrestrial magnetism under the influence of the armor plates of vessels, the navies of various countries have recently taken up again this interesting problem, and O. Martienssen has been intrusted by Siemens & Halske to consider the construction of a rotary compass on the basis of experiments commenced as far back as ten years ago by Werner von Siemens. The following apparatus was accordingly constructed:

The rose of the compass *B* (Fig. 2) is floating in the vessel *A*, filled with petroleum, while resting with a pressure of several grams on the stone-bearing *C*. This rose is itself an air-tight vessel with metal bottom and glass globe, in which the rotating body *E* rests with its axis *M* on the friction wheels *G*. Two electro-motors *F* allow this axis to be imparted a very rapid rotation, the current being supplied from the lower bearing and the bottom of the vessel, on one hand, and the mercury cup H on the other. The rose of the compass carries a lead weight *D* placed underneath and intended for displacing the center of gravity as far down as possible. The position of the axis of rotation is read on one hand from the graduated circle *R* at the bottom of the rose, and on the other from a mark on the outside vessel *A*. This apparatus thus mainly consists of a top or gyroscope, the axis of which is kept horizontal by the force of gravity, and which, along with its support, is free to rotate round a practically vertical axis.

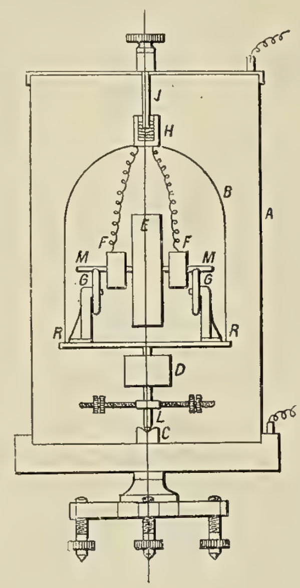


FIG 2.

After studying the theory of the apparatus, Mr. Martienssen undertook a first set of experiments, in the course of which the directive force of the compass rose was, however, found to be very small. The stability of the rose was then increased (by arranging bearings also at its upper end), thus greatly augmenting this directive force and even rendering it in some cases far superior to that of a magnetic compass. On board a vessel there will, it is true, arise some complications from the motion of the ship itself, and in view of these disturbances correct reading can be expected only under special conditions, unless a cardan suspension with fixed axis be adopted. Any variation in the speed will, however, even then result in a deflection from the vertical, which, it is true, remains quite inappreciable as long as the acceleration of the vessel is kept constant.

In order to reduce, as far as possible, the disturbances above mentioned, the duration of an oscillation of the top or gyroscope should be increased to a high extent, which, however, would diminish its suitability as a rudder compass.

Motor Boat Show

The annual meeting of the Motor Boat Show, given under the auspices of the National Association of Engine and Boat Manufacturers of America, is to be held in Madison Square Garden, New York City, Feb. 19 to 26, inclusive.

THE MARINE STEAM ENGINE INDICATOR—VII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

REDUCING MOTIONS.

The maximum stroke or travel of the cord actuating an indicator paper drum averages about 4½ inches, and it is therefore impossible to connect the cord directly to an engine cross-head, except in the case of very small engines or pumps, when the stroke is equal to or less than the length above mentioned. This condition makes it necessary to fit some form of mechanism for reducing the travel of the cross-head to that of the indicator drum. Such appliances are generally known as reducing motions. As the horizontal components of the indicator diagram affect its area and form, it is necessary, if correct results are to be obtained, that the horizontal motion of the card or paper drum be an exact copy of the piston movement.

Probably the most simple reducing motion—which is mathematically correct—is the reducing wheel. The basic principle of this mechanism is as follows: Two wheels of different diameters are keyed to the same shaft; the larger wheel has a circumference equal to the engine stroke, and the periphery of the smaller equals the desired card length. A cord is wrapped

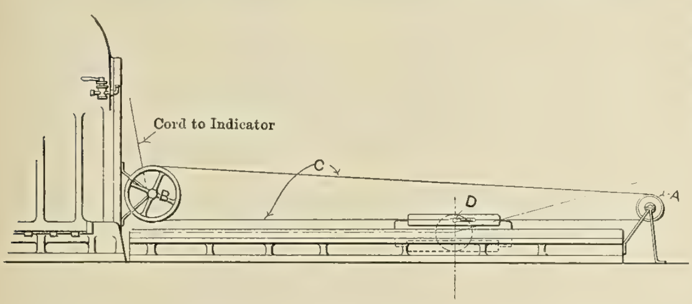


FIG. 50.

about the large wheel and made fast to the engine cross-head, and a cord attached in a similar manner to the small wheel is connected to the indicator. The cord connection between the large wheel and the engine cross-head must be so attached that it will be parallel to the engine center line at all times, and the cord from the small wheel must lead off at 90 degrees with the shaft axis. If these last conditions obtain, the velocity ratio between the engine cross-head and the indicator drum will be constant, and this is the essential feature in all reducing motions. A mechanism constructed in this manner would, in practice, be so heavy—if made to fit a large engine—that the inertia would cause large distortion. The wheels are therefore reduced in diameter, so that the shaft makes several turns during each stroke of the engine, but the proportion between the *circumferences* of the wheels is maintained as before. In most modern forms of this device, take-up or recoil springs are fitted for turning the shafting against the pull of the cross-head cord, and gears are frequently used to get the proper velocity ratios.

An easily made form of reducing wheel, suitable for slow speed, horizontal or inclined engines, is shown in Fig. 50. The wheel A is an idler, and B is the reducing wheel. The belt or cord C is attached to the cross-head at D by means of an off-set stanchion bolted fast to the cross-head. A simple lanyard passed through rings in one end of the cord and on the stanchion is fitted at D for taking up the slack. A round turn is sometimes taken about the reducing wheel. Recoil springs are unnecessary.

A modern form of reducing wheel and one that requires but a single cord leading to the engine cross-head is shown in Fig. 51. This mechanism represents that class which is not fitted with gears, and the particular one illustrated is made by the Trill Indicator Company. When connected up as shown in the figure, the reduction is accomplished in two stages. The cord from the cross-head is first passed through the guide pulley

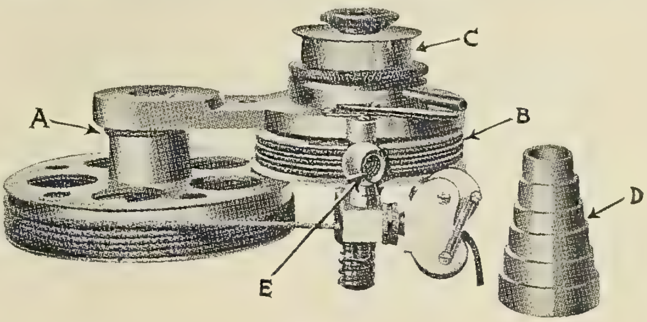


FIG. 51.

and then around the large wheel at the left and its motion reduced in the ratio of 3½ to 1 before it is transmitted to the wheel B by means of the cord, one end of which is shown attached to the boss of the large wheel at A. The wheel B is about 2½ inches in diameter and carries a spiral recoil spring whose tension is adjustable. The upper or small wheel C is attached to the same shaft and revolve with B. This wheel consists of a nest of aluminum bushings (shown in detail at D) clamped to the innermost wheel by the cover plate and

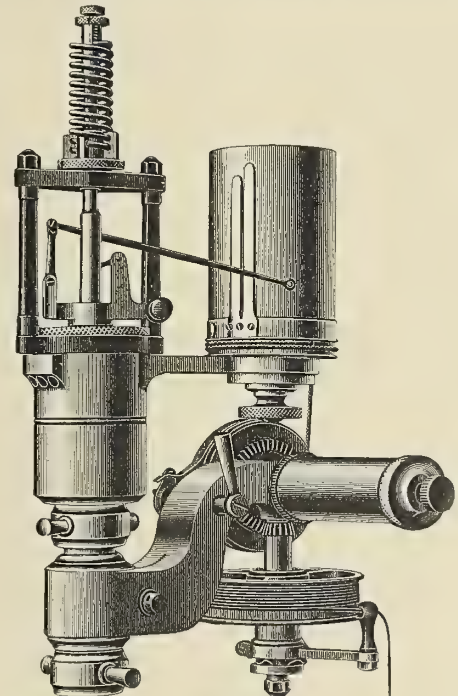


FIG 52.

milled nut at the top. The cord leading to the indicator drum is passed around and made fast to C. The wheel connected up as shown is good for all strokes between 20 and 60 inches. For strokes under 20 inches, the guide pulley is inserted in E, and the large wheel at the left is thrown out of use, the cross-head cord leading directly to the wheel B. The wheel rigged in this manner is good for strokes between 6 and 20 inches, all intermediate changes being made by changing the aluminum bushings shown at D. The two large wheels are made of aluminum to reduce inertia effects. An up-and-down motion is imparted to the cord guide by a square thread on the lower

end of the shaft which carries *B*. One revolution of the large wheel moves the guide an amount equal to the diameter of the cord, so that the end winds on the wheel in a spiral and the turns cannot "ride." This wheel can be bolted to the engine housing, or be so made that it will fasten directly to the indicator frame in place of the guide pulley arm.

The Crosby reducing wheel is shown in Fig. 52, and its operation is at once understood by an inspection of the cut. The take-up spring is helical and is inclosed in the cylindrical case surrounding the horizontal shaft. The rig may be attached directly to the engine cylinder cock, and the indicator in turn secured to the frame of the wheel, as shown in the figure, and in this way no strain is brought on the frame of the indicator. If desirable, the wheel may, of course, be attached to a support located in any position on the engine housing, where a good lead may be obtained for the cross-head cord. Reducing wheels must be used with caution, especially when the rotative speed is high, and the operator should see that the recoil springs are so adjusted that the effects of inertia are reduced to the lowest terms.

(*To be continued.*)

TURBINE PROPULSION—RECENT DEVELOPMENTS.

BY R. M. NEILSON.

The steam turbine, as is well known, is very old, and even the Parsons and De Laval machines date from about 1883; but the era of steam turbine ship propulsion may be said to commence only in January, 1894, when the success of the Parsons steam turbine on land was sufficiently pronounced to lead to the formation in Great Britain of a small syndicate—the Marine Steam Turbine Company—for the purpose of applying this type of motor to the propulsion of ships. The *Turbinia* was built, and the first preliminary trial of this vessel took place on November 14, 1894. It is unnecessary here to mention the first failures and the subsequent success of this vessel, or to trace the developments in turbine ship propulsion from the *Turbinia* to the steam turbine installations of the *Lusitania* and *Mauretania* and recent large battleships and cruisers.* It is intended rather in this article to discuss certain recent developments and proposals relating to steam turbine propulsion.

THE RECIPRO-TURBINE COMBINATION.

It is an old idea, but only within recent years put into practice, to combine a reciprocating high-pressure engine with a low-pressure turbine. A good reciprocating engine can efficiently utilize the available heat energy in steam down to about half an atmosphere—more or less according to the dimensions of the low-pressure cylinder. It can benefit by a vacuum much below half an atmosphere, but its efficiency as regards the work obtained from the available heat energy of the steam below this pressure cannot be said to be high. The efficiency of a steam turbine, on the other hand, may be said to be approximately constant at all stages of the pressure drop down to, say, 1 pound per square inch absolute. The turbine is not, by any means, an ideal motor for the propulsion of ships, because, with the possible exception of high-power, high-speed vessels, its desirable speed of rotation, to secure low weight and low cost and high efficiency, for the turbine is not conducive to high efficiency in the propeller. It is, therefore, not surprising that, at an early date in the history of steam turbine ship propulsion, proposals were made to employ reciprocating engines to utilize the first portion of the available energy in the steam, and turbines to complete the expansion.

* For historical sketch, see "The Steam Turbine," by R. M. Neilson, fourth edition, Longmans & Co.

A combination of reciprocating engines and turbines was installed in the British destroyer *Velox* about eight years ago, but in this case the reciprocating engines are comparatively small and are employed only at cruising speeds when they exhaust into the high-pressure turbines, whence the steam passes to the low-pressure turbines. At high speeds the reciprocating engines are disconnected from the propeller shafts and the steam supplied direct to the high-pressure turbines.

In a torpedo boat built about 1904 by Messrs. Yarrow & Co., Ltd., both reciprocating engines and turbines are employed for propulsion, but the reciprocating engines—which drive the center shaft—are quite independent of the turbines which drive the wing shafts, both types of engine receiving steam direct from the boilers and discharging it direct to the condensers. In the case of the turbines the steam passes in series through a high-pressure and a low-pressure turbine arranged on separate shafts. In the torpedo boat *Goyaz,* built by the same firm for the Brazilian Government, a combination arrangement was also provided, but in this case also the reciprocating engines and the turbines work independently: the former alone are used for reversing and for cruising.

None of these torpedo craft, however, can serve as an example of what can be achieved by the recipro-turbine combination as regards the efficient propulsion of a ship: the *Otaki,* completed little more than a year ago, was the first vessel having reciprocating engines and turbines intended to be run in series at full power.

The *Otaki* has already been described.* Suffice it to say here, that this vessel carries two sets of triple-expansion reciprocating engines which drive wing shafts and exhaust into a single low-pressure turbine, which drives a central propeller shaft. Comparisons between the *Otaki* and a sister ship, the *Orari,* given in a paper read in August last by Engineer-Commander Wisnom (of the builders' firm) before the joint meeting of the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders, showed the *Otaki* to be superior to her sister in point of economy, to the extent of 17 percent on trial at 14 knots, and about 8 percent at the speed employed in service. Further experience with the *Otaki* has demonstrated that her advantage over the *Orari* in service is somewhat greater than 8 percent. Moreover, it was stated by Commander Wisnom, in replying to the discussion on his paper, that the arrangement in the *Otaki* could probably be improved in future ships, so that still better results may be obtained from the combination system.

In the interesting discussion which followed the reading of Commander Wisnom's paper no doubt was expressed as to the greater economy of the combination system over the usual wholly reciprocating drive for the propulsion of vessels of moderate speed; but some doubt was expressed as to whether the gain in economy was worth the extra complication.

It would appear to be necessary to provide more room for the engines and shafting in a vessel having the recipro-turbine combination of machinery than in a similar vessel propelled by the ordinary marine type of engine. In the case of the *Otaki* there was room for the turbine between the two sets of reciprocating engines, so that the dimensions of the engine room were the same as in the *Orari,* but the length of the *Otaki* was made 4 feet 6 inches greater than that of her sister ship, to make up for the loss in cargo capacity, due to three shaft tunnels instead of two. In other cases, however, the length of the engine room in a combination boat might have to be considerably increased above what would be necessary with a simple reciprocating drive, because the provision of a low-pressure turbine allows of but little shortening of the fore-and-aft length of the reciprocating engines, while a large

* International Marine Engineering, February, 1909, and October, 1909.

condenser or condensers are required, which will usually have to be placed aft of the engines. Moreover, cases may occur where there will not be room for the turbine between the two sets of reciprocating engines.

In the case of the White Star boats *Laurentic* and *Megantic,* of which the former has the recipro-turbine combination and the latter the ordinary drive, the *Megantic* is provided with quadruple-expansion tngines, while, owing to the employment of a low-pressure turbine in the *Laurentic,* a triple-expansion arrangement of reciprocating engines has been considered sufficient for this vessel. The low-pressure cylinder in the *Laurentic* has, however, been divided to produce smoother running, so that each vessel has two 4-cylinder sets of engines. The diameters of the cylinders in the *Laurentic* are 30, 46, 53 and 53 inches (the stroke being 54 inches), while the *Megantic's* cylinders are 29, 41½, 61 and 87 inches (with a stroke of 60 inches), so that the difference in the fore-and-aft length of the engines in the two vessels is probably only about three or four feet, and whereas the condensers of the *Megantic* are located in the engine framings, those of the *Laurentic* are independent structures placed aft of the engines.

It may be remarked here that, not only must the condensers and air pumps in a combination boat be larger than are required in a vessel propelled by piston engines only, but, in fixing on the dimensions and design of condenser and air pump, it must not be assumed without investigation that the requirements will be the same as in a vessel propelled by turbines only, because the steam consumption will probably be greater in the latter than in a combination vessel and the air leakage may be either more or less.

As regards space required by the boilers, the greater economy of the recipro-turbine combination will allow of the provision of less steam-generating capacity, so that on the whole it would appear that the total propelling machinery in a combination boat will require little more room than is necessary in a boat propelled by simple reciprocating engines, the precise ratio of space required varying according to the particular conditions in the vessels being considered.

As regards relative weights, the total weight of machinery in the *Otaki* was about 30 tons, or 3.25 percent, more than in the *Orari,* but the boiler installation was the same in the two vessels, whereas less boiler power would have sufficed for the *Otaki* to allow of the same maximum speed being obtained. Had the boiler-room weights of the *Otaki* been reduced, say 10 percent, the total weight of machinery in this vessel would probably have worked out considerably less than that in the *Orari.*

The greater economy obtainable by the combination system will allow of less bunker capacity being provided, and there will be a difference in bunker weights, especially at the beginning of a voyage. This advantage as regards bunkers will be more pronounced in the case of vessels going long trips without recoaling than in the case of ships doing only short runs.

As regards the pressure at which the steam exhausts from the reciprocating engines and is supplied to the turbine, in the *Laurentic* this pressure is said to be about 18 pounds per square inch absolute: in the *Otaki* at full speed the pressure is about 10 pounds absolute, but at a speed of about 11 knots—at which speed the vessel made a round trip from Liverpool to New Zealand and back—the pressure at admission to the turbine is only about 4.5 pounds absolute.

The best pressure at which to transfer the steam from the piston engines to the turbine must be considered for each case, it is obvious that no hard-and-fast rule can be laid down, but it may be said that at the speed at which the vessel most often runs, the transfer pressure should never be less than 7 pounds absolute.

Increase in the transfer pressure reduces the size and weight of the reciprocating engines, while the size and weight of the turbine is not increased by an equal amount. The employment of relatively small reciprocating engines with a high mean effective pressure referred to the low-pressure cylinder is conducive to obtaining high mechanical efficiency, while the effective efficiency of the turbine, or ratio of brake work to the available energy in the steam, is not improved by lowering the admission pressure when this pressure is in the neighborhood of, or below, the atmosphere. The volume of the low-pressure cylinders in the *Otaki* is about 57 percent of that of the low-pressure cylinders of the *Orari,* while the combined volume of the two low-pressure cylinders in each of the sets of piston engines in the *Laurentic* is about 67 percent of the volume of the single low-pressure cylinder in each set of engines in the *Megantic.* The volume in each case is taken as the internal area of section of the cylinders multiplied by the stroke.

Too high a transfer pressure gives the turbine-driven propeller an undue amount of work to do; and it must be remembered that this propeller is the least efficient of the three.

TABLE I.—RECIPRO-TURBINE YACHT EMERALD.*

Transfer Pressure, Lbs. per Sq. In. Abs.	Vacuum, In. of Merc.	Percent of Total Power Developed by	
		Recipro-Engines.	Turbine.
11.6	27.4	70	30
10.6	27.4	72	28
7.0	27.7	79	21

* Prepared from Mr. R. J. Walker's comments on Commander Wisnom's paper before mentioned.

Table I. refers to Sir Christopher Furness' yacht *Emerald,* which was first propelled by steam turbines only, but a little more than a year ago was converted to the combination system. The table gives the percentages of the total power developed by the reciprocating engines and the turbine, respectively, with different transfer pressures. In obtaining these percentages the indicated horsepower of the reciprocating engines, and the shaft horsepower of the turbine, were taken.

TABLE II.—WORK OBTAINABLE FROM THE EXPANSION OF ONE POUND OF SATURATED STEAM.

Initial Pressure Pounds per Sq. In. Abs.	Final Pressure Pounds per Sq. In. Abs.	Total Work Obtainable, Foot-Pounds.	Transfer Pressure Pounds per Sq. In. Abs.	Work Obtainable Before Transfer, Foot-Pounds.	Work Obtainable After Transfer, Foot-Pounds.	Percent of Work Obtainable.	
						Before Transfer.	After Transfer.
250	1.0	270,000	20	146,000	125,000	54	46
			15	160,000	110,000	59	41
			10	176,000	94,000	65	35
			7	192,000	78,000	71	29
200	1.0	260,000	20	132,000	128,000	51	49
			15	146,000	114,000	56	44
			10	163,000	97,000	63	37
			7	181,000	79,000	70	30
170	1.0	250,000	20	124,000	126,000	50	50
			15	136,000	114,000	54	46
			10	154,000	96,000	62	38
			7	172,000	78,000	69	31
140	1.0	243,000	20	112,000	131,000	46	54
			15	126,000	117,000	52	48
			10	144,000	99,000	59	41
			7	161,000	82,000	66	34
250	1.5	255,000	20	146,000	109,000	57	43
			15	160,000	95,000	63	37
			10	176,000	79,000	69	31
			7	192,000	63,000	75	25
200	1.5	244,000	20	132,000	112,000	54	46
			15	146,000	98,000	60	40
			10	163,000	81,000	67	33
			7	181,000	63,000	74	26
170	1.5	236,000	20	124,000	112,000	53	47
			15	136,000	100,000	58	42
			10	154,000	82,000	65	35
			7	172,000	64,000	73	27
140	1.5	227,000	20	112,000	115,000	49	51
			15	126,000	101,000	55	45
			10	144,000	83,000	63	37
			7	161,000	66,000	71	39

Table II. gives the percentages of the work obtainable from the expansion of steam above and below certain transfer pressures. The values are given in round numbers; great exactitude is unnecessary owing to the doubt as to the exact value of the mechanical equivalent of heat.

As regards the maintaining of a high vacuum, which materially affects the shaft power developed by the turbine, there is an advantage in having the transfer pressure above atmosphere, as in this case there is less chance of leakage of air by the glands into the low-pressure cylinders of the piston engines.

SUPERHEATED STEAM.

The employment in steamships of superheated steam has already been discussed in INTERNATIONAL MARINE ENGINEERING.* The writer will, therefore, in this article make no remarks on the construction or arrangement of superheaters or superheating tubes or the difficulties encountered in the superheating of steam or the use of the latter with reciprocating marine engines. A few remarks will, however, not be out of place on the special difficulties in connection with the employment of superheated steam in steam turbines for ship propulsion.

The troubles encountered in the employment of turbines of the Parsons type, both on land and at sea, have not, on the whole, been great, nor have serious accidents been numerous; but a large proportion of the troubles and accidents that have occurred are due to the unequal expansion of different portions of the turbine.

Saturated steam at a pressure of, say, 200 pounds per square inch above atmosphere, has a temperature of about 388 degrees F. The heating of parts of the turbine to nearly this temperature while other parts remain cold may cause quite a considerable relative displacement or distortion; but if the steam is superheated, say, 100 degrees, the conditions are very much worse.

In all turbines of the Parsons type it is desirable to keep the radial clearances at the blades small to reduce the leakage of steam from stage to stage. Any bending or angular distortion of the rotor or casing, therefore, endangers the rubbing of the ends of some of the rotating blades on the interior of the casing, or the rubbing of part of the rotor-drum on the ends of the fixed blades. To reduce the risk of blade-stripping, due to such a rubbing action, the blades are sometimes, according to the Willins-Sankey system (employed in America by the Allis-Chalmers Company), very securely connected together in sections before being attached to the rotor and stator, respectively, and the tips of the blades of each section connected together by a strip of metal of channel section, so that no stripping would appear to be possible without the employment of great force.

Another device for reducing the risk of stripping consists in thinning the blades at their tips, so that when rubbing occurs the tips of the blades will get worn down. As rubbing usually occurs only at one place in the length of the turbine, such rubbing down of the blades and the increased clearance produced will not very greatly affect the efficiency of the turbine as a whole.

Experience has shown, however, that neither of these devices absolutely prevents stripping; and both devices are objectionable, in the author's opinion, as tending to slightly reduce the efficiency of the turbine by upsetting the regular flow of the steam. Moreover, when axial dummies are employed at the glands, or for balancing purposes, no large relative axial movement between rotor and stator is allowable.

The danger of damage through unequal expansion is, therefore, greatly increased when superheated steam is used, although in electrical power stations on land it is the usual practice now to employ superheated steam for all types of turbines, and the machines with care have been found to work quite satisfactorily, the accidents, considering the number of turbines now in use, being comparatively infrequent. It must be remembered, however, that in electrical power stations there is usually at least one unit in reserve, which is not the case as regards the use of turbines in the propulsion of ships.

A recent patent of the Hon. Charles A. Parsons relates to the employment of a heat buffer intended to be placed between the steam turbine and the boiler or superheater, so as to shield the turbine from abrupt changes of temperature. The buffer is a heat reservoir, which reduces or increases the temperature of the steam passing to the turbine as required, so as to prevent any sudden admission of very hot steam to the turbine, and also to reduce any violent fluctuations in the temperature of the fluid at any time.

During the last year or two, proposals to employ superheated steam on turbine steamships have been looked at with somewhat less disfavor than formerly; and the employment of steam superheated to a moderate amount, say 50 to 75 degrees F., appears probable in the near future. With superheated steam it will be unnecessary to generate steam in the boilers at a very high pressure, which, in the case of vessels employing firetube boilers (and this class includes practically all turbine-propelled steamships except war vessels), is a matter of considerable importance.

SINGLE-SHAFT VS. DIVIDED-SHAFT ARRANGEMENTS.

The *Turbinia* was successfully propelled by turbines only when three shafts were provided and a turbine placed on each shaft, the three turbines being arranged in series as regards the flow of the steam. In all later vessels propelled by Parsons turbines, three or more turbines have been provided on independent shafts. Several arrangements are shown diagrammatically in Figs. 1-8, in which the following abreviations are used:

TUR. = Complete expansion turbine.
H. P. T. = High-pressure turbine.
I. P. T. = Intermediate-pressure turbine.
L. P. T. = Low-pressure turbine.
C. T. = Cruising turbine.
H. C. T. = High-pressure cruising turbine.
L. C. T. = Low-pressure cruising turbine.
R. T. = Reversing or astern turbine.
H. R. T. = High-pressure reversing turbine.
L. R. T. = Low-pressure reversing turbine.
CON. = Condenser.

A vessel could not be efficiently propelled by a single propeller driven by a steam turbine of the Parsons type; more than one propeller on a single shaft is objectionable; and, therefore, a plurality of shafts must be employed. This being so, it is undesirable to divide the expansion of the high-pressure steam over more units than necessary, as the smaller the units the poorer the efficiency. The arrangement of one high-pressure turbine driving a central shaft and two low-pressure turbines, each driving a wing shaft (as shown in Fig. 1), therefore appears very suitable; and this arrangement has been very generally adopted. Bulkhead arrangements, however, or the desirability of distributing the thrust over more than three propellers, has frequently called for the employment of four shafts, and two high-pressure turbines have then been employed (as shown in Figs. 4, 6 and 8).

Recently other types of turbines than the Parsons have been employed for propelling ships; for example, the Curtis, the A. E. G. (Allgemeine-Elektricitäts-Gesellschaft), the Zoelly and the Schichau (Melms-Phenninger) and the manufacturers of these turbines have preferred to adopt what has been called the "single-shaft" arrangement. This does not mean that only a single propeller shaft is employed to propel the vessel,

* INTERNATIONAL MARINE ENGINEERING, July, 1909; August, 1909, and October, 1909.

but that the expansion of the steam is completed in a turbine or a pair of turbines on one shaft, each shaft being thus independent of the others; either two or three shafts are employed. This single-shaft arrangement is more suitable for use with impulse turbines than with turbines of the Parsons type, but to explain this matter satisfactorily would necessitate entering into a discussion of the theory of action of steam turbines, which would be beyond the scope of the present article.

Much discussion has taken place, especially in Germany, as to the relative advantages and disadvantages of the single-shaft and divided-shaft arrangements.

In many cases a single-shaft arrangement has an advantage where the propelling machinery is split into two or more compartments by water-tight bulkheads. In Fig 7 is shown, diagrammatically, the arrangement of the A. E. G. turbines in a battleship. The machinery is divided by two longitudinal bulkheads into three compartments, each of which is independent of the other two. Fig. 5 shows, diagrammatically, an arrangement of Curtis turbines in which there are two engine rooms separated by a cross-bulkhead. The turbines in the two engine rooms are, as before, independent of each other, but in this case the steam for the aft turbine has to pass

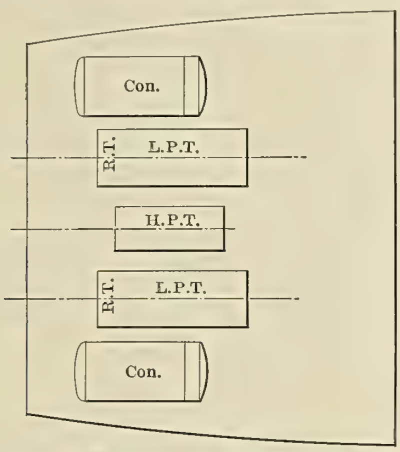


FIG. 1.—ARRANGEMENT OF MACHINERY IN THE CROSS CHANNEL STEAMER LONDONDERRY, PARSONS TURBINES.

through the forward engine room. Figs. 4, 6 and 8 show, diagrammatically, bulkhead arrangements employed with Parsons turbines. It will be seen that, while in some cases the single-shaft arrangement lends itself better to the division of the engine rooms, in other cases the one system appears to have no advantage over the other in this respect.

In vessels driven by Parsons turbines it has always been considered desirable to provide at least three shafts. In vessels, however, propelled by impulse turbines, two shafts have often been considered sufficient, the turbines rotating at a lower speed and allowing of the employment of propellers of larger diameter, the employment of two shafts instead of three generally involves less waste of space as regards shaft tunnels, and the propellers are less liable to interfere with each other.

There appears to be little difference in total weight of machinery between the two systems, although the best dimensions and speeds of rotation for any type of marine turbine have yet to be settled for all classes of vessel.

When three shafts are employed with the single-shaft arrangement, the wing turbines alone can be employed, or the center turbine alone employed, for propelling the vessel; and this, in the case of a warship, gives an opportuninty for overhauling the turbines while the vessel is cruising.

With the single-shaft arrangement both or all three shafts, as the case may be, are arranged to reverse. With the divided-shaft arrangement, usually two shafts only are arranged to reverse, and sometimes only one shaft. In British battleships fitted with turbines, however, all the shafts are arranged to reverse, Fig. 6 showing the arrangement diagrammatically. The high-pressure reversing turbines in these ships must be of material assistance in going astern, but constitute an additional drag when the vessel is going ahead.

The attachment of the blades to the rotor in impulse turbines is usually of a much stronger nature than in the case of Parsons turbines; on the other hand, the large size and weight of the impulse turbines must be an objection in some

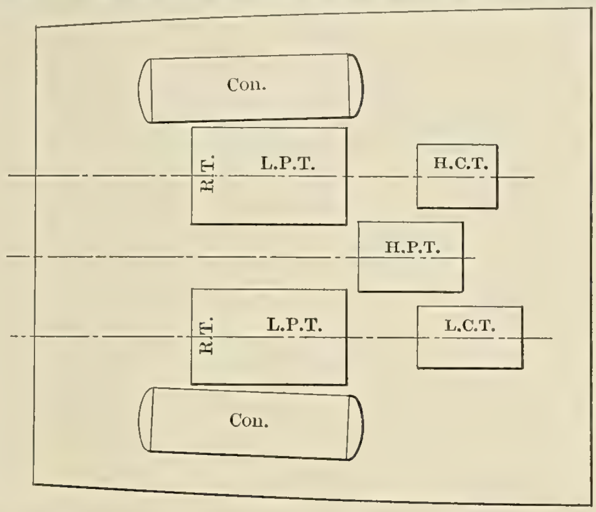


FIG. 2.—ARRANGEMENT OF MACHINERY IN A DESTROYER, PARSONS TURBINES.

cases as regards putting these engines aboard ship or removing them from the vessel.

CRUISING TURBINES.

The first British warship to be driven by steam turbines was the *Viper*, and during the short life of this vessel it was remarked that the coal consumption at cruising speeds was very high. To meet this difficulty the destroyer *Velox*, built shortly afterwards, was provided, as already mentioned in this article, with two small sets of triple-expansion engines, which were used only at cruising speeds, the object—which was attained—being to obtain a greater economy at cruising speeds. Immediately after the *Velox* was completed, the Parsons Marine Steam Turbine Company introduced cruising turbines, and these have been fitted on a large number of

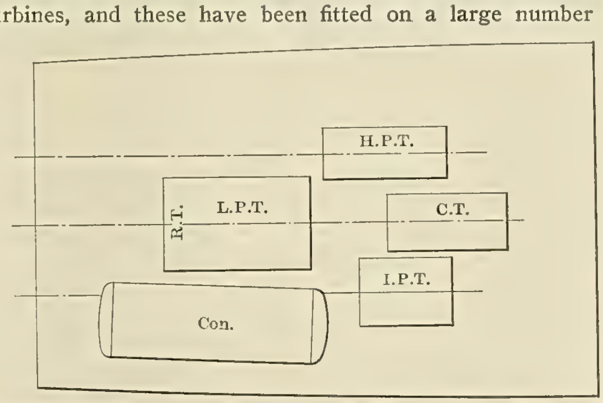


FIG. 3.—ARRANGEMENT OF MACHINERY IN A TORPEDO BOAT. PARSONS TURBINES.

British warships—battleships, cruisers and torpedo craft. The usual practice has been to provide two cruising turbines, called, respectively, the high-pressure cruising turbine and the low-pressure cruising turbine, these turbines being placed at the forward end of the engine room and on separate shafts. (See Figs. 2, 4 and 6.) When the vessel is cruising and the engines require to develop only a small fraction of their full power, the steam is passed in series through the several turbines of the vessel in the following order: First, through the

high-pressure cruising turbne; then through the low-pressure cruising turbine; then through the high-pressure main turbine or turbines, and then through the low-pressure main turbines. When, however, the vessel is running at full, or nearly full, speed, and during reversing or maneuvering, the cruising turbines are put out of action and steam supplied direct to the main high-pressure turbine or turbines. Sometimes only one cruising turbine is installed, as shown in Fig. 3.

It has not been the practice to disconnect the shafts of the cruising turbines when these latter are not required, but to allow the rotors to rotate idly, and, in order to diminish the drag, to connect the turbines to the condenser so that the rotors rotate in the condenser vacuum.

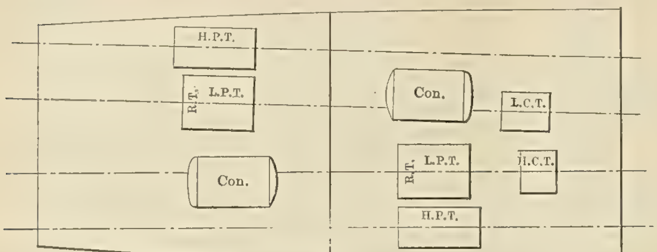


FIG. 4.—ARRANGEMENT OF MACHINERY IN U. S. SCOUT-CRUISER CHESTER, PARSONS TURBINES.

These cruising turbines have fulfilled the purpose for which they were originated, but their use involves several objections.

In the first place their weight is considerable, and they are usually employed in warships in which weight is of great importance. The two cruising turbines of the *Dreadnought* are said to weigh together between 80 and 90 tons, which is a serious addition to the weight of machinery, when it is considered that these turbines do not in any way assist the vessel at full speed.

In the second place, the drag of the cruising turbines, when rotating idly, although small, is appreciable.

In the third place, the cruising turbines increase the chance of air leakage into the condenser and involve two further elements, which require to be looked after and are liable to injury or breakdown; and although the cruising turbines can be very quickly cut out of action whenever required, it must be remembered that any accident to their rotors necessitating the stopping of these also necessitates the stopping of the turbines which drive the same propeller shaft until the damaged turbine can be uncoupled from the other.

In the fourth place, when a longitudinal bulkhead separates the two cruising turbines one from the other, as shown in Fig. 6, and when, therefore, each is under independent control, a certain amount of inconvenience must arise through each being dependent on the other, as either cruising turbine cannot be put into, or out of, action without affecting the other, and also affecting both high-pressure turbines (if two are employed),

The last objection could be got over by making each cruising turbine independent of the other, although in this case nearly half the advantage of their employment would be lost.

The British Admiralty have abandoned the use of cruising turbines in recently designed battleships and cruisers, although they are retained for some or all of the new destroyers. The cruising power of a destroyer is a smaller fraction of the full power than in a battleship, so that the advantage to be obtained by the use of cruising turbines would appear to be greater in the former than in the latter. Moreover, the turbines of a destroyer weigh considerably less than those in a battleship in proportion to the total engine power of the vessel, partly by reason of the greater speed of rotation, which can be adopted in the case of the destroyer, so that the gain in weight by omitting the cruising turbines is proportionately less in the destroyer than in the battleship.

To partly compensate for the omission of the cruising turbines in the new British battleships and cruisers, the main turbines are designed, at the expense of slightly extra weight, to better suit the conditions existing during cruising, and for higher speeds a by-pass arrangement is brought into use on the principle of that now well know in connection with Parsons turbines employed on land. This by-pass device does not appear to be so suitable for use with marine turbines as for turbines driving electric generators, because, in the latter case, constant speed is required at all powers, whereas in a ship-propulsion turbine the speed of rotation is less at low than at high powers. Now, the blade speed in a turbine depends on the speed of rotation of the rotor, and the desirable steam speed depends on the blade speed. The adoption of cruising turbines, by greatly increasing the number of stages, affects a very substantial decrease in the steam speed. A by-pass arrangement also affects the steam speeds, but in a somewhat unscientific manner and not to the same extent. The aggregate disadvantages of cruising turbines are, however, so considerable that the substitution for them of a by-pass device in the case of battleships and cruisers is no doubt justified.

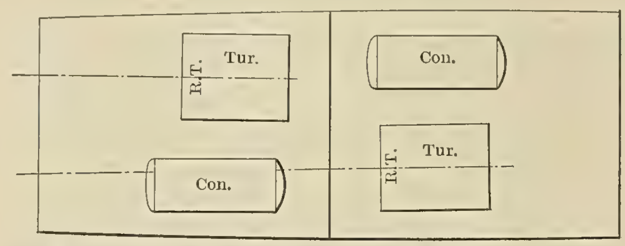


FIG. 5.—ARRANGEMENT OF MACHINERY IN U. S. SCOUT-CRUISER SALEM, CURTIS TURBINES. SAME IN TORPEDO CRAFT.

Cruising turbines have not, as far as the writer is aware, been employed with any except Parsons turbines.

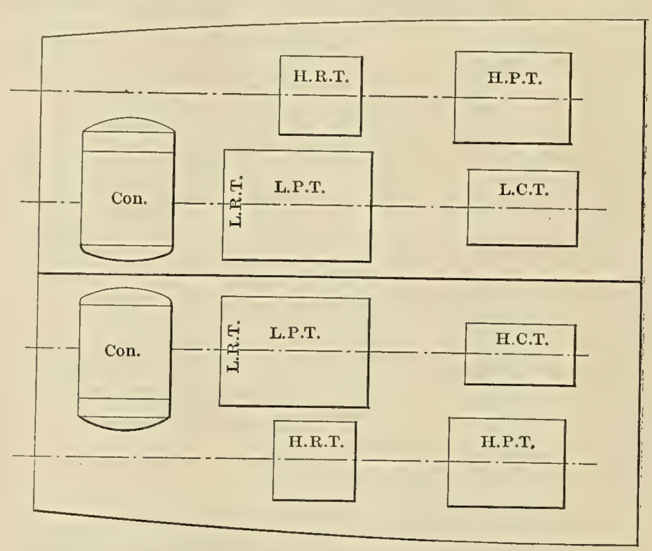


FIG. 6.—ARRANGEMENT OF MACHINERY IN A BATTLESHIP, PARSONS TURBINE.

TURBO-ELECTRIC PROPULSION.

Much dinscussion has recently taken place in Great Britain on the question of employing steam turbines to propel vessels, not by a direct drive, but by electric transmission of power.

As is well known, the great difficulty in applying steam turbines to propel ships has resided in the fact that a high speed of rotation is desirable for the turbine, and a moderate or low speed of rotation for the propeller. In practice a compro-

mise has been struck, so that a reasonable propeller efficiency has been obtained combined with a fair efficiency in the turbine; but, nevertheless, the propeller efficiency has not been as high as would be expected had a lower rotative speed, combined with a different design of propeller been adopted, and the efficiency of the turbine has not been as great, nor has its weight and size been as low as could have been obtained had the turbine been allowed to rotate at a higher speed.

To obtain high turbine efficiency, low turbine weight and bulk, and the maximum propeller efficiency, it has been proposed to employ a high-speed turbine or turbines to drive an electrical generator or generators, which supply current to motors driving one or more propeller shafts. The scheme is attractive, but on careful and unbiased consideration it does not appear to have the prospect of such extensive adoption as some of its advocates would have us believe.

For cargo boats in which first cost and maximum economy are of primary importance, the turbo-electric drive would appear to offer the prospect of a reduced coal consumption, and, moreover, it might be possible to slightly reduce the space occupied by, and the weight of, the total propelling machinery, including boilers, so that the dimensions of a vessel to carry a given weight or bulk of cargo could be very slightly reduced. The reduction in initial cost of hull and the saving in coal during working would not, however, in the writer's opinion, be sufficient to compensate for the extra cost of the electrical machinery. In an estimate which the writer got out for the relative costs of two vessels to carry the same cargo, the one propelled by ordinary reciprocating engines, and the other using the turbo-electric system of propulsion, it appeared that the saving on the hull by adopting the latter system of propulsion would be about $1,947 (£400), but the extra cost of machinery would be about $43,799 (£9,000). The engine power in both cases was, or was equivalent to, 2,000 indicated horsepower. The difference in coal economy cannot be accurately estimated, but it will be obvious that steamship owners will not pay a very large sum on additional outlay for a more complicated installation of machinery unless there is a reasonable chance that the saving in coal will recoup them in 10 or 15 years. It must be remembered that a cargo steamer is usually lying at port during a considerable portion of her time.

As regards the application of the turbo-electric drive to warships, warship machinery is at present much more expensive than that of cargo boats; and the difference in initial cost between a direct-turbine drive and a turbo-electric drive would not be so great as to represent a serious obstacle to the adoption of the latter if it showed decided advantages in other respects. The engine-room weights per maximum horsepower in a warship are, however, so low that the adoption of the turbo-electric drive would very seriously increase them, and although greater economy could no doubt be secured, and the boiler-room weights consequently reduced, it is difficult to see how it would be possible to prevent a decided increase in the total weight of all the propelling machinery. Less coal would be required to be carried with the turbo-electric drive for a given radius of action, but it does not appear that this would compensate for the extra weight of machinery, unless a radius of action were called for much greater than has been usual in the majority of recently-built battleships and cruisers. For torpedo craft the turbo-electric drive is quite out of the question.

It should be noted that in recent British battleships and cruisers very good turbine and propeller efficiencies have been obtained, the high power of the vessels being conducive to the obtaining of a low steam consumption combined with a speed of rotation enabling a very fair propeller efficiency to be obtained.

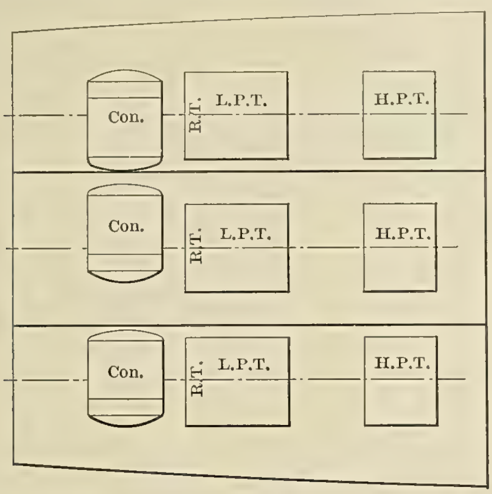


Fig. 7.—Arrangement of Machinery in a Battleship, Impulse Turbines.

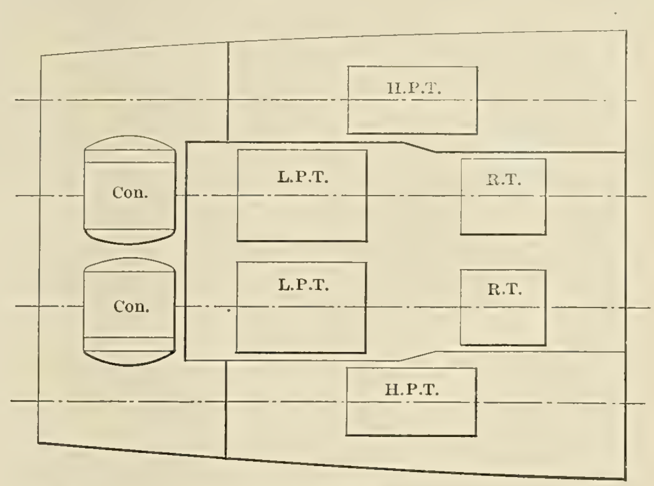


Fig. 8.—Arrangement of Machinery in the Mauretania, Parsons Turbines.

Vice-Admiral Oram, engineer-in-chief of the British navy, in a recent address to the Junior Institution of Engineers (Great Britain), has stated that the British Admiralty have given careful consideration to the question of the turbo-electric drive, and he lets it be inferred that he does not, at present at least, consider it as desirable to adopt in any British warship.

Fast passenger steamers may be said to be intermediate between warships and cargo boats, as regards the weight of their machinery, so that their case need not be discussed. It appears extremely doubtful if the turbo-electric drive has any chance of adoption for this class of vessels either. For special vessels, however, such, for example, as dredgers, in which the turbines and electric generators might be employed for two purposes, the turbo-electric drive appears to have special advantages, and its adoption in such special cases may be anticipated.

GEARING.

It is an old idea—which, however, is only now being tried—to gear down the speed of the turbine so that the propeller shaft can rotate at a very much lower speed than the turbine. Gearing for the transmission of great powers is no doubt to be avoided where possible, but the advantages to be derived from its employment on turbine steamships are so great that it occasions some surprise that, until recently, no attempt seems to have been made to gear down a steam turbine for the propulsion of a ship. Experiments are, however, now

being made and will be watched with very great interest. It should be noted that the problem of gearing down the speed of a steam turbine is very different from the problem, which occupied the minds of engineers in the early days of steam propulsion, of gearing up the speed of a reciprocating engine.

HYDRAULIC TRANSMISSION OF POWER.

The Vulcan Company of Stettin, Germany, have recently devoted much time and money to research work on electric, hydraulic and other transmission gear for use on turbine steamships, and their Dr. Föttinger has recently invented an hydraulic reduction and reversing gear whereby it appears possible, with fair efficiency, to transmit the power of a high-speed turbine to a low-speed propeller shaft. The transmission gear comprises a primary water turbine, mounted on the steam-turbine shaft, and a secondary water turbine, mounted on the propeller shaft. The primary water turbine converts the shaft power of the steam turbine into hydraulic power, which is reconverted into shaft power by the secondary water turbine. An efficiency of over 80 percent is said to have been abtained with this hydraulic gear.

SCREW PROPELLERS.

Much progress has been made during the past few years in ascertaining the best design and dimensions of propellers for use on ships propelled by steam turbines. The early turbine steamships had all two or more propellers on some, at least of their shafts—the destroyer *Cobra* had twelve propellers in all—but experience has shown that the best results are obtained with each shaft carrying one propeller only. The research work has no doubt involved much expense, but the results are most valuable. The shaft horsepower required to produce a given speed in a given type of vessel can now be estimated with much more reliance than was the case a few years ago. Higher propeller efficiencies than have yet been recorded for turbine steamships may yet be obtained with further experience and without the necessity of reducing the speed of rotation; but the same efficiency as is now obtained in certain classes of vessel driven by reciprocating engines rotating at 70 to 100 revolutions per minute can hardly be expected.

Large Marine Gas Engines and Gas Producers.

That producer-gas installations for marine work will be thoroughly investigated by the United States navy is evident from the attitude of H. I. Cone, engineer-in-chief of the Bureau of Steam Engineering, who makes the following recommendation regarding this matter in his annual report:

"The development of large gas-engine machinery operated in connection with gas producers is rapidly progressing. The Bureau is of the opinion that this prime mover is worthy of much more serious investigation and experiment than has yet been given it in our navy.

"It is possible to design a marine plant composed of bituminous coal-gas producers furnishing power to gas engines. There are several such plants already in existence; although they are small, they prove the feasibility of extending this system of developing power to larger installations. Great possibilities for improving the economical operation of machinery are offered by the producer-gas engine combination. We cannot afford to delay development of the gas engine for naval use until commercial gas-engine plants, directly adaptable to naval use, are regularly on the market, and it is, therefore, recommended that special authority be secured in the next appropriation act for the diversion of not more than $250,000 of the appropriation "Steam Machinery" for the purchase and installation of a producer-gas engine plant in one of our colliers, if at any time during the year such an expenditure is deemed advisable."

BRITISH SHIPBUILDING IN 1909.

When reviewing a year ago the British shipbuilding of 1908 we had to present a sorry record. The cost of building new merchant steamers declined fully 10 percent in that year. It cannot be said to have actually declined further in 1909, because last year the tendency of the prices of material was upwards—at all events in the latter portion of the year. Yet it is probable that some contracts were booked at even lower prices than in 1908, so desirous were the builders in the first six months to obtain work to keep their plants going. In many cases it is admitted that orders were accepted below cost price —at all events without any allowance for establishment charges. Good-sized, well-found cargo-carrying steamers were booked as low as $24.58 (£5.5/–) per ton of deadweight capacity, and some even at $24.33 (£5), if not lower, though in the second half of the year higher prices were exacted. And perhaps the feature of the year has been the number of new contracts for cargo tramps that have been booked, though they do not yet appear in the records of launches.

The output of 1909 is better than that of 1908, and the advance is accounted for principally by cargo steamers. The attitude of the tramp owner is a fair clue to the condition of the shipping industry. Early in 1909 the owners of the better class of tramps began to make inquiries for prices, and soon began to place orders. Since then a good many contracts have been placed, and the shipyards are gradually coming back to normal. A feature of the 1909 shipbuilding trade was the improved relations between employers and men. The experiment in copartnery ownership made by Sir Christopher Furness at Hartlepool is merely an experiment, but the note in all industrial negotiations just now is concilliation. The agreement between the Shipbuilding Employers' Federation and the shipyard trade unions is working smoothly, and has settled a good many disputes that would in previous years have endangered the peace of the trade. The removal of the headquarters of the Engineering Employers' Federation from Glasgow to London will make that organization still more national in character, and a still more powerful influence for peace.

The year has been notable for the performances of the Cunard liners *Lusitania* and *Mauretania*, which have proved themselves capable of fulfilling all the conditions of their contracts and more. They have proved that high speed can be combined with absolute regularity of running. None of the other big lines has yet followed the example of the Cunard Company in the matter of turbines, and the "combination" engine, though it is very successful in the New Zealand steamer *Otaki*, is still in abeyance. On the White Star liner *Laurentic*, in the Canadian service, it is understood to have proved as economical and efficient as the highest type of steamer with twin-screw reciprocating engines. The "combination" engine is, however, only a compromise. We still await a motor that will conjoin the merits of the fast-moving turbine and the slow-moving propeller, and that will dispense with the coal-steam boiler.

CONDITIONS ON THE CLYDE.

Turning first to the Clyde as the premier shipbuilding river of the kingdom, we find that some of the ground lost in 1908, when the production fell from the record of 620,000 tons to 355,000, was regained in 1909 by an increased tonnage of about 48,000. This is not very much, but enough to encourage the belief that 1907 was the bottom of the period of depression, and that coming years will see a further improvement. The

figures for 1909, while better than those of previous year, are (except 1908) the lowest since 1897, and they are less by 215,000 tons than the record of 1907. Several of the yards were idle for two or three months, but as trade improved they obtained orders, and as the year closed they had practically all, with one exception, something on the stocks. There were no labor troubles throughout the year. As to the output, I again adopt the very complete statistics collected by the *Glasgow Herald,* which I know to be reliable.

The following table gives a summary of the work of each Clyde firm and also their tonnage for 1909:

	1909 Tons.	1908 Tons.
Russell & Co	55,519	48,619
Wm. Denny & Bros	33,391	20,875
Wm. Hamilton & Co	28,859	11,386
The Fairfield Company	27,688	17,520
Charles Connell & Co	25,468	30,698
Alex. Stephen & Sons	21,353	19,904
Scotts' Shipbuilding Co	21,259	4,171
A. MacMillan & Son	19,637	9,715
Greenock & Grangemouth Company	17,526	6,524
Barclay, Curle & Co	15,250	38,810
Clyde Shipbuilding Co	13,305	7,201
London and Glasgow Co	12,129	......
A. Rodger & Co	11,339	1,801
Napier & Miller	11,076	16,211
Caird & Co	10,883	16,723
John Brown & Co	10,154	15,300
D. & W. Henderson & Co	7,625	17,805
Wm. Beardmore & Co	6,000	11,533
Ailsa Shipbuilding Co	5,980	5,985
Wm. Simons & Co	5,870	7,933
Fleming & Ferguson	5,600	5,050
R. Duncan & Co	5,222	......
Lobnitz & Co	4,605	6,663
Yarrow & Co	2,488	2,813
Mackie & Thomson	2,725	2,157
Ferguson Bros	2,480	3,086
John Fullerton & Co	2,438	1,883
Alley & MacLellan	2,430	2,930
The Campbeltown Co	2,404	......
Mechan & Sons	1,645	4,205
A. & J. Inglis	1,561	6,777
The Ardrossan Co	1,464	1,517
D. J. Dunlop & Co	1,254	2,308
George Brown & Co	1,193	978
Scott & Sons	1,022	1,629
D. M. Cumming	990	157
Bow, McLachlan & Co	934	2,370
Murdoch & Murray	617	282
Ritchie, Graham & Milne	540	377
John Reid & Co	414	412
William Fife & Son	199	297
P. Macgregor & Sons	157	314
Other Firms	491	577
	403,187	355,586

Clyde builders turn out many kinds of craft, and the following table shows the types of vessels launched during the year:

	No.	Tons.
Screw Steamer	139	348,741
Warships	13	16,974
Dredgers	23	9,579
Lighters and Barges	63	8,954
Turbine Steamers	2	4,104
Pontoons, docks, etc	3	3,250
Train Ferries	2	3,032
Hopper Steamers	4	2,980
Tugs	10	1,609
Paddle Steamers	4	1,539
Rock Cutters	7	682
Fishing Steamers	6	648
Motor Boats	54	543
Sailing Yachts	20	333
Steam Yachts	2	189
Launches	2	30
	354	403,187

The year was not one of notable merchant vessels, either in size or design. There were seven launched of more than 10,000 tons each, all representing the art of the builders and engineers at its best, but none marking an epoch. The following were some of the notable ships built in United Kingdom in 1909:

Vessel.	Tons.	Builders of Vessel.
Balmoral Castle	13,100	Fairfield Co.
Orvieto	12,130	Workman, Clark & Co.
Osterley	12,129	London & Glasgow Co.
Otranto	12,124	Workman, Clark & Co.
Mantua	10,883	Caird & Co.
Ruahine	10,758	Wm. Denny & Bros.

There is not much of novelty in the Clyde details. Russell & Company turned out the largest tonnage on the river, improving on 1908 by about 7,000 tons. Denny & Bros. launched thirty-one vessels of 33,394 tons, a considerable proportion of the total being steamers for the Far East. They had only three turbine vessels—the destroyer *Maori* and two railway steamers for service on the Fleetwood and Belfast route. William Hamilton & Company launched four vessels on the *Isherwood* principle, for which the firm holds a license. The Fairfield Company launched three Queenborough-Flushing Channel steamers, one second-class cruiser, one destroyer, and one Union-Castle mail liner. John Brown & Company launched three destroyers, a paddle steamer for the Thames, and a big twin-screw steamer for the Huddart-Parker Company, of Melbourne. Yarrow & Company, specialists in light shipbuilding, turned out eight warships of the smaller types for four foreign governments, as well as boilers for a British destroyer and internal-combustion engines for two Austro-Hungarian gunboats.

The tonnage of warships and turbine steamers was low, but in the case of warships the average will be kept up by the output of 1910. The Clyde obtained the contract for only one of the "contingent" battleships, but it received a large share of the work which the Admiralty allocated during last year. The battleship contract went to Beardmore's, who are completing the second-class cruiser *Gloucester* and laying down an improved sister ship. At Clydebank, John Brown & Company have launched three of their six destroyers, and have three others, as well as the cruiser *Bristol,* on the stocks. At Fairfield the cruiser *Glasgow* is completing, one destroyer has been launched, and there are five to come for the British Government and two for the Commonwealth of Australia. The London & Glasgow Shipbuilding Company have on hand the destroyer *Rattlesnake* and an improved Bristol cruiser. The engines for the former have been made by Yarrow & Company, and those for the latter by John Brown & Company. A destroyer placed recently with A. & J. Inglis is taking shape on the berth. Yarrow & Company have two of ten Brazilian destroyers and some other light craft to launch. At Dumbarton, Denny & Company have completed the large destroyer *Maori,* and have three others still to launch, as well as one for Australia. At Greenock, Scotts' Company are making progress with the battleship *Colossus,* the order for which was placed with them last summer. Of authorized Admiralty contracts not yet allocated there are the two Colonial battleships.

There are not many merchant vessels of outstanding importance at present building on the Clyde. The Fairfield Company have only destroyers on the stocks, the London & Glasgow Company have no mercantile work, but at Pointhouse, A. & J. Inglis have a "MacBrane" Line steamer, an Italian railway steamer, and a passenger steamer for Australia. D. & W. Henderson have three vessels, each of 7,000 tons; Mackie & Thomson two trawlers and one small Booth Line steamer; Alex. Stephen & Sons, three steamers of 19,000 tons aggregate; Barclay, Curle & Company, three; Charles Connell & Company, a Donaldson liner and one other vessel, and John Brown & Company, a Harwich & Hook of Holland, steamer, and a steam yacht. At Renfrew, Lobnitz & Company are building a rock-cutter, a large hopper barge, a stern-wheeler, a gold dredger and a small barge, and Simons & Company two

dredgers. Napier & Miller, Old Kilpatrick, have four steamers on the stocks, making altogether about 11,600 tons. At Dumbarton, Denny & Bros. have on hand a steamer for the New Zealand Shipping Company, and a large vessel for P. Henderson & Company's line, and MacMullan & Son have two on the stocks and two to lay down, making altogether for Dumbarton a total of about 34,000 tons. The work is now fairly well distributed, but some of the smaller establishments have very little on hand. The yards in Greenock and Port-Glasgow have orders representing over 100,000 tons, but the work there has not been well distributed. Several of the eleven firms have almost fully-occupied berths where others have little or none. H. M. S. *Colossus* is in progress in the yard of Scotts' Company. The busiest firms are Russell & Company and William Hamilton & Company, more than half of the estimated tonnage being in these two yards. In both cases the vessels are cargo steamers for service in various parts of the world. Quite a number building by William Hamilton & Company are on the Isherwood system. On the lower Firth of Clyde there is not very much doing. The Ailsa Shipbuilding Company are building at Ayr and Troon a passenger steamer of 1,850 tons, a ferry steamer of about 400, and a cargo steamer of 1,450. The Ardrossan Company have on hand a paddle steamer of 455 tons and a cargo steamer of 750 tons, and the Campbeltown Company four steamers of about 13,000 tons. Altogether the work on hand on the river amounts to about 250,000 tons of merchant shipping and 73,000 tons of warships, a total of 323,000 tons, as compared with a little over 300,000 in 1908.

REPORTS FROM THE ENGLISH DISTRICTS.

The English districts show better than at the end of the previous year. There has not been anything like the revival to bring the industry on the Northeast Coast back to normal; but there has been some recovery from the depression of 1908. There is a further decrease of tonnage on the Tyne—from 336,000 in 1907 to 210,000 in 1908, and to 199,000 in 1909, but the Wear advanced from 85,000 to 132,000, the Tees and Hartlepool from 96,000 to 122,000, the Mersey from 39,000 to 85,000, and the Humber from 21,000 to 24,000 tons. The net English increase is nineteen vessels, 115,547 tons, and 194,200 indicated horsepower. The improving conditions on the Wear and Tees are noteworthy, as these districts were harder hit by the depression than any others. They depend almost entirely on the building of cargo steamers, and they have nothing in the way of liners or special craft to keep them going. An advance of nearly 200,000 indicated horsepower in marine engines constructed occurred on the Tyne and at Barrow and Birkenhead. The increase of 84,000 on the Tyne was in destroyers, built by Palmer's Company, cruiser turbines by the Wallsend Slipway Company, warship work done by the Parsons Company, and the increased number of steamers built at their own yard, which Swan, Hunter & Wigham Richardson have engined. At Barrow and Birkenhead warship machinery is also the distinguishing feature of the engineering returns. The following table summarizes the output of the several English districts:

	1909			1908		
	Vessel.	Tons.	I. H. P.	Vessel.	Tons.	I. H. P.
The Tyne	112	199,307	262,993	115	210,110	178,665
The Wear	57	132,633	95,556	40	85,351	81,803
Tees and Hartlepool	46	122,733	69,025	38	96,001	66,489
Mersey to Solway	92	85,228	164,950	95	39,232	68,836
Royal Dockyards	6	46,612	......	5	43,060	......
The Humber	72	24,414	35,375	98	21,714	27,720
English Channel	104	9,920	68,101	106	10,237	66,504
The Thames	96	7,053	11,618	112	9,881	23,723
Bristol Channel	57	5,399	762	14	2,106	443
	642	633,299	708,383	623	517,752	514,183

Notwithstanding improving trade the Tyne has failed to improve on its output for 1908, and as the tonnage for that year was a good deal less than that of 1907, the total for 1909 was much under the capacity of the river. Swan, Hunter & Wigham Richardson again lead, with an output of 71,000 tons, somewhat less than 1908, but sufficient to give them second place for the world. In the tonnage of the district there are a cruiser, two scouts and six torpedo boat destroyers, while there is a large amount of naval work still on hand. In engineering, the Wallsend Slipway Company lead with 55,800 indicated horsepower, included in which are the turbines for a cruiser. The Parsons Company have constructed only warship turbines during the year—for the Brazilian scouts built at Elswick and the battleship *St. Vincent,* built at Portsmouth dockyard. Prospects generally are improving, and there is a fair amount of work on hand. The following shows the output of each of the Tyne yards:

	Vessel.	1909		1908	
		Tons.	I. H. P.	Tons.	I. H. P.
Swan Hunter, etc.	23	71,000	22,650	60,266	7,750
The Northumberland Co.	9	41,472	......	19,028	......
Hawthorn, Leslie & Co	6	17,230	41,500	12,810	34,500
Armstrong Whitworth	10	15,964	......	51,384	......
John Readhead & Sons	4	15,352	7,500	7,844	5,000
Wood, Skinner & Co	5	8,590	......	4,832	......
Tyne Shipbuilding Co	3	8,423	......	10,512	......
Blyth Shipbuilding Co	10	6,276	......	6,725	......
T. Stephenson & Co	1	4,386	......	5,940	......
Smith's Dock Co	20	4,322	......	6,151	......
Palmers Shipbuilding Co	3	1,620	31,300	7,149	16,100
J. P. Rennoldson & Sons	6	1,553	5,024	745	3,155
Wm. Dobson & Co	1	1,387	......	14,702	......
J. T. Eltringham & Co	3	937	......	1,154	......
Hepple & Co	8	795	1,740	868	810
Wallsend Slipway Co	......	......	55,800	......	33,175
N. Eastern Marine Co	......	......	46,742	......	44,240
Parsons Turbine Co	......	......	36,500	......	15,000
Shields Engineering Co	......	......	7,360	......	8,750
G. T. Grey	......	......	5,020	......	10,035
Baird Bros	......	......	1,800	......	150
Total	112	199,307	262,996	210,110	178,665

The Tyne is, of course, the birthplace of the turbine. For marine purposes engines of this type were fitted to the historic *Turbinia* in 1894 by the inventor, the Hon. C. A. Parsons. Turbines of the largest size have been constructed in different engine works in the district for battleships and mercantile vessels, including those for the *Mauretania,* built by the Wallsend Slipway & Engineering Company. The same firm has machinery for the battleship *Orion* now in hand. Recent orders include turbine machinery for the new Armstrong Dreadnought from Hawthorn, Leslie & Company, who have already engined H. M. S. *Temeraire* and *Collingwood.* Boilers and reciprocating engines of the largest size are constructed by several firms, while the premises of the North Eastern Marine Engineering Company, which claims the largest output of marine boilers and reciprocating engines of any firm in the world, are situated at Wallsend-on-Tyne.

The majority of the Wear yards did a good deal better than 1908, although there seems to be a falling off in turret steamers, of which there are only two in Messrs. Doxford's list. This firm also launched the self-discharging collier *Pallion,* equipped with belt-discharging appliances which deliver the coal into barges. Another interesting vessel is the *Montoria,* built by Osborne, Graham & Company, on a new principle—that of longitudinally grooved sides, which enable the vessel to steam at a given speed with less horsepower than would otherwise have been required. The Wear tonnage for the year shows a marked improvement over 1908, which was less than a third of the year before, and prospects are improving. Quite a number of orders were booked in the autumn, and most of the yards are now fairly busy. The following shows the output of the several Wear yards:

SHIPBUILDING ON THE WEAR.

	Vessel.	1909		1908	
		Tons.	I. H. P.	Tons.	I. H. P.
Wm. Doxford & Sons	8	28,393	13,650	20,271	8,500
Short Bros	8	20,237	......	10,054	......
J. L. Thompson & Sons	5	19,269	......	10,465	......
The Sunderland Co	6	13,706	......	3,296	......
R. Thompson & Sons	6	13,488	......	5,301	......
Bartram & Sons	2	7,433	......	3,738	......
S. P. Austin & Son	5	7,029	......	1,725	......
John Crown & Sons	6	6,583	......	2,640	......
Osbourne, Graham & Co	5	5,950	......	5,317	......
W. Pickersgill & Sons	3	5,090	......	2,968	......
John Blumer & Co	1	2,838	......	6,309	......
J. Priestman & Co	2	2,617	......	3,513	......
Sir James Laing & Sons	......	......	......	9,754	......
N. E. Marine Company	......	......	*37,155	......	*23,440
John Dickinson & Sons	......	......	19,311	......	11,683
George Clark, Ltd	......	......	10,050	......	22,400
Richardsons, Westgarth & Co	......	......	*9,800	......	*6,900
MacColland Pollock	......	......	5,590	......	8,880
	57	132,633	95,556	85,351	81,803

* Sunderland only.

The revival in trade also affected the Tees and Hartlepool district, though not quite so strongly as on the Wear. The total for the year, while better than that of 1908, is only about half that of 1907. The following shows the output of the several Tees and Hartlepool yards:

	Vessel.	1909		1908	
		Tons.	I. H. P.	Tons.	I. H. P.
William Gray & Co	8	30,517	17,300	25,071	17,764
Irvine's Shipbuilding Co	11	30,126	......	12,549	......
Ropner & Sons	4	16,939	......	5,005	......
Richardson, Duck & Co	8	15,606	......	7,519	......
Sir Raylton Dixon & Co	6	12,661	......	26,146	......
Craig, Taylor & Co	4	9,368	......	5,105	......
R. Craggs & Sons	2	4,972	......	10,935	......
W. Harkness & Son	3	2,544	......	3,731	......
Richardsons, Westgarth & Co	......	......	28,650	......	24,550
Blair & Co	......	......	23,075	......	24,175
	46	122,733	69,025	96,061	66,489

The following shows detailed output of the Northwest yards:

	Vessel.	1909		1908	
		Tons.	I. H. P.	Tons.	I. H. P.
Vickers, Sons & Maxim	6	60,200	122,110	12,487	58,850
Cammell, Laird & Co	30	19,707	40,234	19,142	7,520
W. J. Yarwood & Sons	12	1,789	396	1,744	806
Lytham Shipbuilding Co	17	1,597	1,690	1,637	1,660
Abdella & Mitchell	2	170	520	1,230	......
Other Firms	25	1,765	......	2,992	......
	92	85,228	164,950	39,232	68,836

OUTPUT OF THE ADMIRALTY DOCKYARDS.

The output of the Admiralty Naval Dockyards was 46,612 tons displacement in six vessels, as compared with 43,060 tons displacement in 1908. The details are summarized below:

VESSEL.	Type.	Tons.	I. H. P.	Built at
Neptune	Battleship	20,250	27,000	Portsmouth.
Indefatigable	Arm. Cruiser	19,000	43,000	Devonport.
Bellona	Scout Cruiser	3,360	18,000	Pembroke.
Blanche	Scout Cruiser	3,360	18,000	Pembroke.
Two Vessels	Submarines	642	......	Chatham.
		46,612		

Machinery all contract.

In the following table the production of each of the establishments is compared with the totals for the nine preceding years. Sheerness is not now a building yard, but does a great deal of overhauling and fitting torpedo craft. The Medway yard at Chatham has built no armored vessel since 1906, but does heavy repairs and refits, and last year constructed submarines:

YEAR.	PORTSMOUTH		CHATHAM		PEMBROKE		DEVONPORT		SHEERNESS	
	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.	Ves.	Tons.
1909	1	20,250	2	612	2	6,720	1	19,000	..	......
1908	1	19,250	2	630	1	3,300	1	19,250	..	......
1907	1	18,600	..	......	1	14,600	1	18,600	..	......
1906	1	17,900	1	14,600	..	......	1	14,600	..	......
1905	..	......	1	16,350	1	13,550	1	16,350	..	......
1904	2	32,700	1	10,850	1	13,550	..	......	..	......
1903	1	9,800	..	......	..	......	1	16,350	2	2,140
1902	..	......	2	20,880	1	9,800	2	20,880	..	......
1901	1	9,800	1	14,000	2	23,900	1	14,000	3	3,210
1900	1	2,200	..	......	..	......	..	......	3	3,030

The battleship *Orion* is on the stocks at Portsmouth, and the armored cruiser *Lion* on the stocks at Devonport, the scout cruiser *Blonde* on the stocks at Pembroke, and two submarines at Chatham.

CONSTRUCTION IN IRISH YARDS.

We turn now to the Irish shipyards, and find that 1909 was one of the years in which Harland & Wolff do not appear among the first two or three firms in the volume of tonnage launched. The place at the top is now taken by Workman, Clark & Company, although their output of 88,952 tons is short of the figures which usually takes first place. Meantime Harland & Wolff's yard has been arranged to make room for the two 45,000-ton White Star Liners *Olympic* and *Titanic*, both of which will probably figure in the 1910 return of launches; and besides these the firm have quite a number of large liners on hand. The following shows the output of the Irish yards:

	Vessel.	1909		1908	
		Tons.	I. H. P.	Tons.	I. H. P.
Workman, Clark & Co	16	88,952	76,550	50,303	38,400
Harland & Wolff	6	29,708	46,250	106,528	65,840
Dublin Dockyard Co	5	1,808	......	1,574	......
Larne Shipbuilding Co	8	400	......	221	......
Tyrrel & Sons	2	36	......	......	......
MacColl & Co	......	......	950	......	1,250
	37	120,904	123,750	158,626	105,490

The Dublin Dockyard Company, it should be noted, launched recently a noteworthy twin-screw coal elevator for the London & North Western Railway Company, for special service in Holyhead Harbor. This vessel, which is named *Herald*, is for coaling the steamers of the company's fleet, about twenty of which require to be coaled daily. It is calculated that the coaling of each vessel's bunkers from the new steamer will occupy only from ten to twenty minutes.

SUMMARY.

We can now sum up the production of the United Kingdom. The following table shows increases of tonnages and horsepower in Scotland and England, decreased tonnage and increased horsepower in Ireland:

	1909			1908		
	Vessel.	Tons.	I. H. P.	Vessel.	Tons.	I. H. P.
Scotland	418	427,325	638,310	680	400,194	528,872
England	642	633,299	708,383	623	517,752	514,183
Ireland	37	120,904	123,750	22	158,626	105,490
U. K. Totals	1097	1181528	1470443	1325	1076572	1148545

S. S. HERMAN FRASCH.

The *Herman Frasch* is a single-screw steamship, constructed by the Fore River Shipbuilding Company, Quincy, Mass., to the highest class in the American Bureau of Shipping and British Corporation Registry. The vessel is of the single-deck type, constructed with Simpson patent topside tanks, forming three large self-trimming cargo holds, each operated by twin hatchways having the De Russett patent covers.

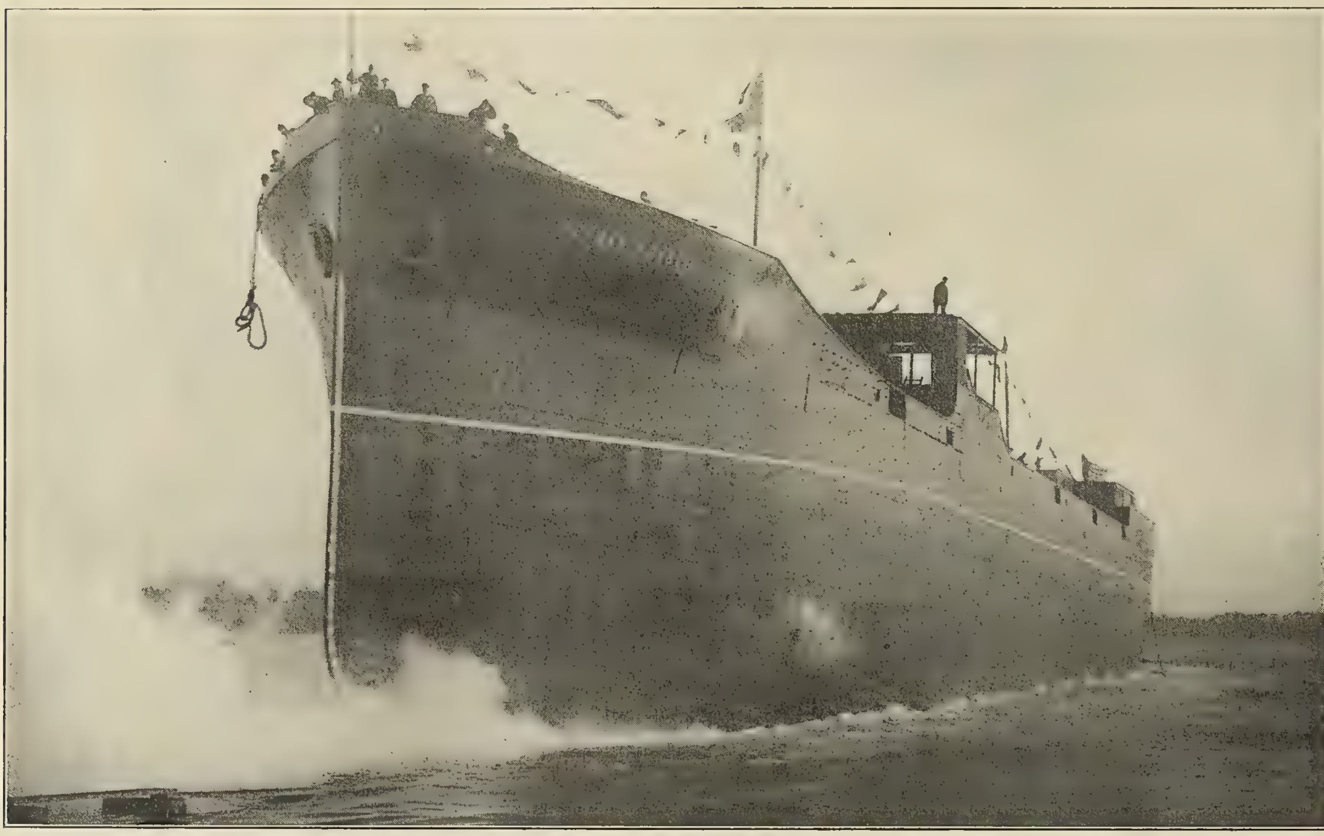
The after part is built up to form a long poop with Liverpool house on top, in which are berthed the engineer officers and their assistants. A short bridge, with bridge house, is arranged forward of amidships, with quarters for the captain, navigating officers, saloon, chart room, pilot house, etc., while forward the vessel is built up to form a topgallant forecastle, with anchor-handling appliances.

The *Herman Frasch* has a straight stem and semi-elliptical stern, has the machinery arranged aft, and is rigged with three pole masts, from the tops of the forward two of which there is rigged a wireless telegraphy outfit.

The vessel has been designed specially for the carriage and operation of bulk freight expeditiously, and for this purpose is fitted with kingposts, operating twin booms, on which are carried the Spencer-Miller patent marine transfer, capable of discharging the cargo at a rate of over 300 tons per hour.

The principal dimensions are as follows:

Length over all	361 feet.
Length between perpendiculars	345 feet.
Breadth	48 feet 3 inches.
Depth	30 feet.
Draft	23 feet 6 inches.
Load displacement	8.770 tons.
Indicated horsepower	2,100
Speed	10.5 knots.



LAUNCH OF THE HERMAN FRASCH.

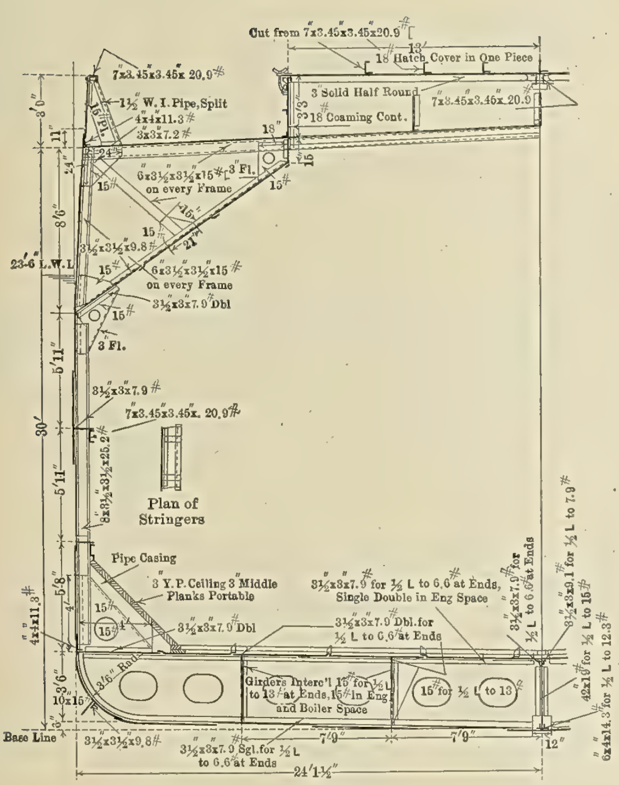
THE HULL.

The keel plate is 47 inches wide by 35 pounds for half the length amidships and aft, reduced to 29 pounds at the forward end. The center keelson, which is continuous, is 42 inches by 19 pounds for half the length amidships, reduced to 15 pounds at the ends. In the machinery space it is 70 inches by 19 pounds. The double angles joining the center keelson to the keel plate are 6 inches by 4 inches by 14.3 pounds for half the length, reduced to 12.3 pounds at the ends. There are also double angles at the top of the center keelson, 3½ inches by 3 inches by 9.1 pounds amidships, reduced to 7.9 pounds at the ends.

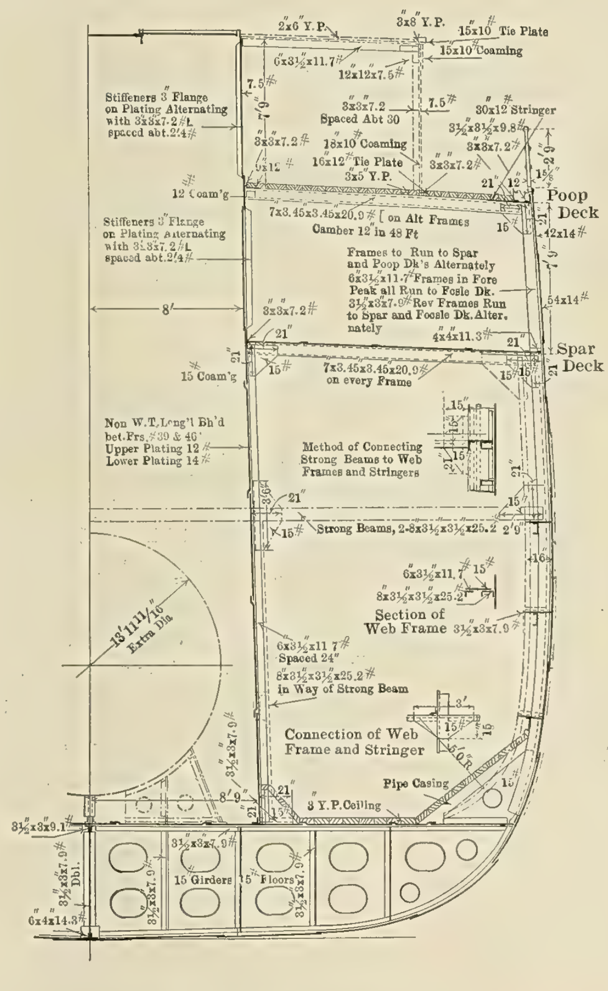
In addition to the center keelson there are two intercostal longitudinals on each side of the center keelson. These are of 15-pound plate for half the length amidships, reduced to 13 pounds at the ends. The floors are continuous, of 15-pound plate for half the length amidships, and of 13-pound plate at the ends. There are five water-tight bulkheads, the lower half being constructed of 14-pound plate and the upper half of 12-pound plate. There are both vertical and horizontal stiffeners. The vertical stiffeners are 7-inch by 3.45-inch by 3.45-inch by 20.9-pound channels, spaced 24 inches apart. There are three horizontal stiffeners on each bulkhead, of the same-size channel bars as the vertical stiffeners. The bulkheads are bracketed to the inner bottom, but are joined to the deck simply by double angles.

The frames, up to the top-side tanks, are 8-inch by 3½-inch by 3½-inch by 25.2-pound channel bars, spaced 24 inches apart throughout. In the top-side tanks they are 6-inch by 3½-inch by 3½-inch by 15-pound channels. In the peak tanks the frames consist of 6-inch by 3½-inch by 11.7-pound angles, with 3½-inch by 3-inch by 7.9-pound reverse bars. The frames are bracketed to the inner bottom by 15-pound brackets, and midway between the margin plate and top-side tank there is a

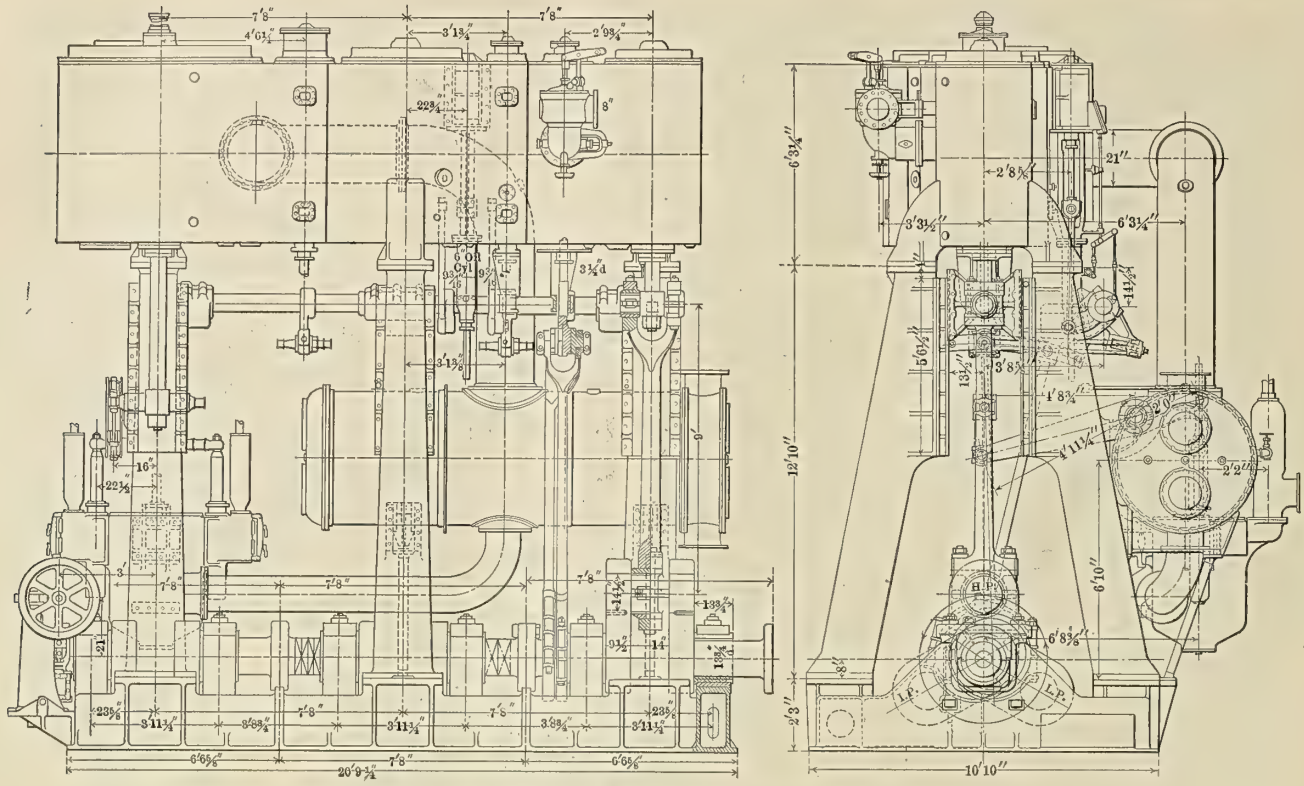
INTERIOR OF ONE OF THE MAIN HOLDS OF THE HERMAN FRASCH.



MIDSHIP SECTION.



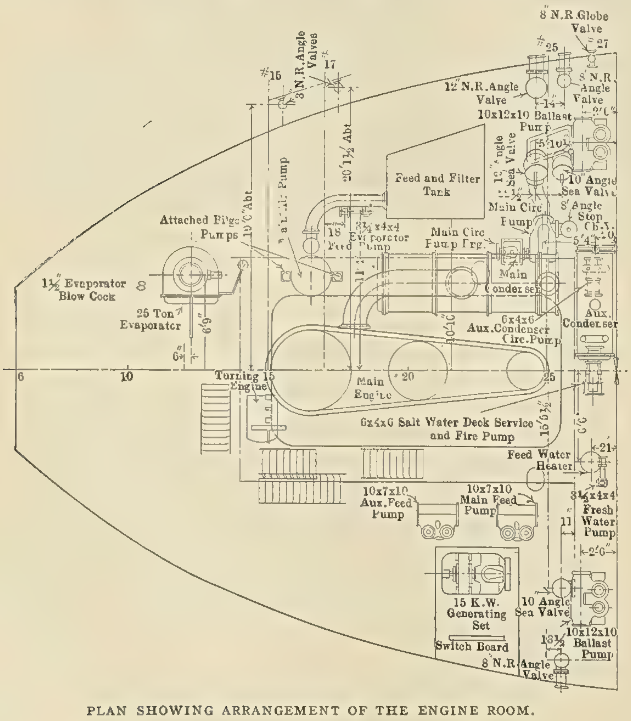
SECTION THROUGH THE BOILER ROOM.



THE MAIN ENGINE WITH CONDENSER AND DIRECT-CONNECTED AIR AND BILGE PUMPS.

15-pound intercostal stringer, joined to the shell plating by 3½-inch by 3-inch by 7.9-pound single intercostal angles, and carrying at the inner edge a continuous 7-inch by 3.45-inch by 3.45-inch by 20.9-pound channel.

The garboard strake of plating is 65 inches by 23 pounds for half the length amidships, reduced to 18 pounds at the ends. The bottom plating is 65 inches by 21 pounds for half the length amidships, reduced to 18 pounds at the ends. The bilge strake is 25 pounds for half the length amidships, reduced to 18 pounds at the ends. The side plating is 60 inches by 23 pounds for half the length amidships, reduced to 18 pounds at



PLAN SHOWING ARRANGEMENT OF THE ENGINE ROOM.

the ends, while the sheer strake is 42 inches by 34 pounds for half the length amidships, reduced to 18 pounds at the ends.

The top-side tank is formed of 14-pound plate for half the length amidships, reduced to 12 pounds at the ends. The plating is riveted to 3½-inch by 3½-inch by 9.8-pound angle-bars, spaced on every frame. These bars are braced to the main deck beam brackets by angle-bars, 6 inches by 3½ inches by 3½ inches by 15 pounds on every frame.

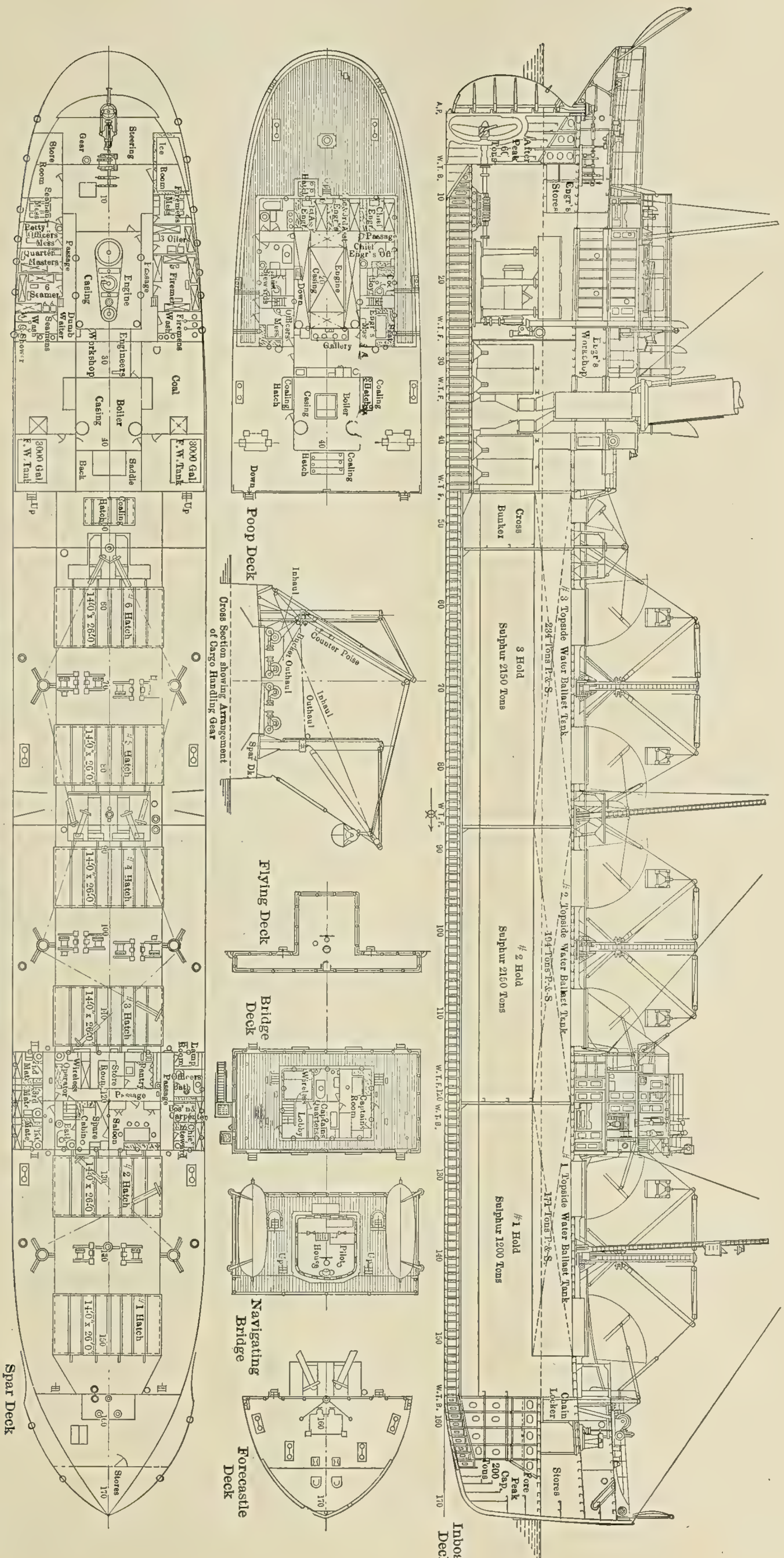
The spar deck beams consist of 6-inch by 3½-inch by 3½-inch by 15-pound channels on every frame. The spar deck is a complete steel deck throughout, the stringer plate being 48 inches by 28 inches for half the length amidships, reduced to 36 inches by 20 pounds at the ends. The deck plating is 14 pounds for half the length, reduced to 12 pounds at the end, while the plating next to the hatches is 18 pounds amidships, reduced to 16 pounds at the ends.

There are six cargo hatches, 14 feet by 26 feet, two to each hold.

THE BOILERS.

Steam is supplied by three single-ended Scotch boilers, designed for a working pressure of 180 pounds per square inch. The boilers are 13 feet 9 inches mean diameter and 11 feet 10 inches long. Each has three corrugated furnaces, 42 inches inside diameter, leading to separate combustion chambers. The grates are 4 feet 9 inches long, and the grate area for each boiler 50 square feet. There are three hundred and one, 2½ inches outside diameter, .12 inches thick, ordinary charcoal iron tubes; forty-three, 2½ inches outside diameter, stay tubes, .259 inch thick at the bottom of the thread, and twenty-four, 2½ inches outside diameter, marginal stay tubes, .38 inch thick to the bottom of the thread, making a total of 368 tubes in each boiler. The heating surface of the tubes is 1,821 square feet; of the furnaces, 132 square feet; of the combustion chambers, 214 square feet, making a total of 2,167 square feet. The ratio of heating surface to grate area is, therefore, 43.4 to 1. The tube area in each boiler is 9.82 square feet, mkaing a ratio of grate area to tube area of 5.09.

The shells of the boilers are in two courses of 1 5/16-inch



INBOARD PROFILE AND DECK PLANS OF THE HERMAN FRASCH.

plate. The girth seams are double-riveted lap joints, with 1¼-inch diameter rivets spaced about 3⅞ inches. The longitudinal joints are triple-riveted, double-butt strap joints, fastened with 1¼-inch rivets, the inner rows being spaced 4 inches and the outer 8 inches between centers. The efficiency of the plate in this joint is 83.6 percent and of the rivets 92.7 percent. The lower half of the back head is 15/16 inch thick and the upper half ⅝ inch. The front head is 15/16 inch thick. Above the tubes the heads are stayed by nineteen through stays, 2 7/16 inches diameter. There are also two of the same sized stays below the tubes above the center furnace, while below the furnace, between the center and outer ones, on each side are three 2 7/16-inch through stays, and above the outer furnaces on each side one 1½-inch stay. The stay-bolts in the combustion chamber are 1⅝ inches diameter, spaced 7¾ inches, both vertically and horizontally.

THE MAIN ENGINES AND AUXILIARIES.

The main engines consist of one set of triple-expansion engines, with cylinders 25 inches, 41 inches and 68 inches diameter and 48-inch stroke.

The condenser, which is mounted on brackets on the columns of the engine, is cylindrical, 4 feet in diameter and 11 feet long between the tube sheets. It has a total cooling surface of 3,010.84 square feet. The air pump, 24 inches by 20 inches, and two bilge pumps, 4½ inches by 20 inches, are driven direct from the low-pressure cross-head. There is a centrifugal circulating pump, driven by an 8-inch by 8-inch engine, with a 12-inch suction and discharge.

The auxiliaries include two high-pressure feed pumps of the Worthington Admiralty pattern, 10 inches by 7 inches by 10 inches; two Worthington ballast pumps, vertical duplex, 10 inches by 12 inches by 10 inches; one salt-water deck service and fire pump, 6 inches by 4 inches by 6 inches, and one fresh-water pump, 3½ inches by 4 inches by 4 inches, the two latter being of Worthington's make. There is an auxiliary condenser with 700 square feet of cooling surface, the pump for this being 6 inches by 6 inches. In addition to the high-pressure feed pumps there is one Hancock injector, with a 2-inch suction and a 2-inch discharge for the main boilers.

The electrical equipment includes one 15-kilowatt, 115-volt, direct-connected General Electric Company's marine generating set. A steam heating system is installed throughout the living quarters.

The cargo is handled by the Spencer-Miller marine transfer system, the installation including ten Lidgerwood hoists, each operating a ¾-yard clam-shell bucket, capable of discharging 50 tons per hour per hatch. Therefore, the cargo can be discharged at the rate of over 300 tons per hour.

The deck machinery consists of a Hyde steam windlass, a Hyde steam capstan, located on the poop, and a steam steering gear. There are also two double-drum winches located on the poop.

The total bunker capacity is 700 tons. Provision is made for 2,000 tons of water ballast and 125 tons of fresh water and stores, making the total deadweight capacity 6,125 tons.

Experiments with Oil Fuel Burners.

During the past year experiments were made by the Bureau of Steam Engineering, United States navy, with an installation for burning oil fuel on board the monitor *Cheyenne*. The system used was one in which the oil is atomized by compressed air after having first been passed through heaters.

In his annual report, Engineer-in-Chief H. I. Cone states that the results of the experiments were very satisfactory, and the installation has increased the ability of the vessel to maintain a constant steam pressure and to develop a high power for long priods without tiring out the personnel.

The Bureau has concluded, however, that this system is not the most desirable for use in naval vessels on account of the weight and space required for the necessary air compressors, and also on account of the desirability of having the heavier vessels so fitted that either oil or coal, or both fuels in combination, may be used, as desired, as coal can be obtained wherever a ship may go, while the ports at which oil fuel may be obtained are limited. With this latter consideration in view, the Bureau is fitting in larger vessels only such oil fuel systems as operate by mechanical atomization of the fuel under high temperatures, the necessary air for the combustion being supplied by the regular forced-draft blowers of the vessel.

A Submarine Armored Cruiser of 4,500 Tons.

BY N. PORTUGALOF.

After the Russo-Japanese war there arose in the Russian fleet, principally among the younger members of the crews, a sense of the necessity for fundamental reforms in all the branches of the naval department in order to avoid further defeats. Russia has three separate seas washing shores which are of great importance to her, and since she has no intermediate bases, there is no immediate possibility of forming in these seas fleets exceeding in size and strength those of her neighbors. Recognizing this peculiarity of geographical situation, there exists in Russia a considerable party which is working to develop the various lines of naval power to meet it. The latest novelty in this direction is a project for a submarine cruiser of 4,500 tons, invented by the naval engineer B. Shuravleff, who formerly worked on the augmentation of the seagoing capacity of modern battleships, and succeeded in having his ideas applied on the new Russian ships which have recently been laid down.

His project for a submarine cruiser has for its object the building of a ship capable of acting in the Baltic Sea, as well as in the Pacific, in view of which it has—in comparison with other submarines—a very low hull (only 25 feet from keel to top of conning tower), with a displacement of 4,500 tons. This makes it possible for the cruiser in question to attack ships of the line even in the shallow waters of the Baltic. If we take into consideration the latter purpose the submarine has a tremendous sea-going capacity; *i. e.*, 18,000 miles, which is of immense importance for Russia, inasmuch as she has only one naval base in the Far East—Vladivostok—with the probable necessity for sending ships from the Baltic.

The speed of the cruiser makes it possible for it to act against large ships, as it is designed for a speed of 26 knots under water.

For defense against the smaller shells of the enemy, if for some reason the cruiser should not be able to dive in time, it has a 2-inch armored deck, with an incline of 3½ inches and an interior shell of ¾ inch, which permits of its diving even in case of injury to the fastenings of the armored deck.

The armament consists of thirty-six torpedo guns of recent construction, convenient for holding torpedos for a considerable time, and which have at the same time a wide range of fire. Besides torpedoes the cruiser also carries about 200 floating mines, which can be placed either under or on the water. For a secondary battery the cruiser has five 4.75-inch quick-firing guns, located in a revolving turret.

A special construction of the Kingston valves and tanks permits quick diving and gives the vessel a light balance.

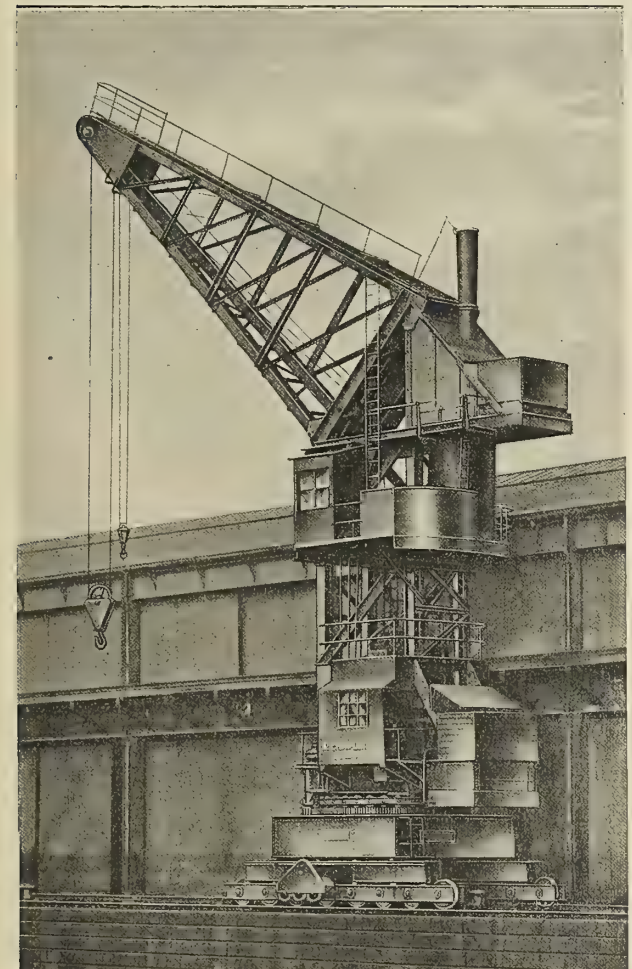
The naval engineer Shuravleff has designed three variations of this cruiser: One fitted exclusively with Diesel internal-combustion engines, which are being used more and more in the Russian fleet, and two with Curtis turbines and White-Forster boilers, the latter being well known in the English fleet, and new ones of the Russian inventor Tabulevitsch.

In the two latter variations of the cruiser there exists a special arrangement for the economic speed, which allows the cruiser the same sea-going capacity as it has with internal-combustion engines alone; *i. e.*, 18,000 miles.

Not only would such a submarine cruiser afford comparative safety against the enemy, but its comparatively large tonnage, allowing to be manned for a considerable time, thus removing one of the principal defects met with in submarines; *i. e.*, the impossibility of action when same are at a distance from their base of operation. This indicates the possibility of a submarine fleet which shall have all the properties of an ideal fleet.

25-Ton Steam Traveling Wharf Crane.

A 25-ton steam traveling wharf crane, which is of somewhat special construction, has recently been built by Alex. Chaplin & Company, of Govan, Glasgow, and has been erected at the Prince's Dock Berth of the Allan Line steamers, which is a very short distance from the company's works. The conditions as regards space were not particularly favorable, and this fact, together with the great height of the steamers now



SPECIAL TYPE OF WHARF CRANE.

in use in the American trade, made it necessary to adopt the special design shown. The crane is built to travel on rails of 11-foot gage, the carriage being mounted upon sixteen wheels, so as to distribute the weight of the crane, which with the load is more than 200 tons, over as large an area of the quay wall as possible. Upon this carriage the structure of the crane is built. The height of the tower, which has vertical sides, is 50 feet above the rails, which allows it to carry the jib clear of the sides of the highest vessels. At the top of this tower the jib is built outwards, to give a radius of 40 feet, and the height of the end of the jib is 75 feet above the rails.

On account of its great height and narrow base the stability had to be carefully considered. The machinery and the back-balance weights are placed immediately above the traveling carriage, and in this way the center of gravity of the crane is kept low. The driver's cabin is erected at the level of the spring of the jib, and from it all the motions are easily worked. At the rear and at the same level another strong platform is erected, which carries the boiler, water tank and coal bunker. In accordance with the practice which has been largely adopted by the builders, a separate set of engines is used for each motion.

Contracts for the Argentine battleships, proposals for which have been under consideration for some time, have been placed in the United States. Both ships are to be built from plans submitted by the Fore River Shipbuilding Company, Quincy, Mass. Only one of the ships will be built by the Fore River Company, however, since it is stipulated that not more than one vessel shall be built in the same yard. The other vessel will be built by the New York Shipbuilding Company, Camden, N. J., and the machinery for both will probably be built by the Fore River Shipbuilding Company.

The Canadian naval programme, as outlined in the Naval Defense Bill recently presented by Sir Wilfred Laurier, provides for four 4,800-ton protected cruisers, one 3,300-ton unarmored cruiser and six destroyers of the improved river type. According to the Premier's estimate the construction of these vessels in Great Britain would cost slightly more than $11,000,000, and about one-third more if built in Canada. It is the intention, if possible, to have the ships built in Canada, and if this is done the shipbuilding industry there will be placed on a desirable footing, since there is already a law under which the Government pays practically the whole of the annual interest charges on the capital invested in drydocks. Moreover, in addition to this it is expected that a bounty on shipbuilding will also be provided.

From the returns compiled by "Lloyd's Register of Shipping," it appears that, including warships, there were 331 vessels of 913,374 gross tons under construction in the United Kingdom at the close of the quarter ending Dec. 31, 1909. Of this, 298 vessels, aggregating 908,373 gross tons, were steel steamers. The tonnage now under construction is about 135,000 tons more than that which was in hand at the end of the last quarter, and about 149,000 tons more than that building twelve months ago.

The co-partnership arrangement entered into a year ago between Sir Christopher Furness and his employees has proved successful and is to be continued. The experiment was originally undertaken for a year, and at the outset it was looked upon with doubt by the trades unions, where it was feared that the supposed beneficiaries would be committed to more work for the old rate of pay. While this doubt has not been entirely dispelled, the employees say that such excellent results have been obtained that they are anxious for a further trial. Even during the first year the returns which the workmen had received on their cash investments in the concern have amounted to a moderate increase in wages. Since the outlook for shipbuilding in Great Britain is now brighter than it has been in many years, the development of the plan will be watched with interest. It will be remembered that the workmen shareholders were to receive a 4 percent dividend on their share of the capital, while the ordinary shareholders were to be paid at the rate of 5 percent.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

A Leaky Feed Heater.

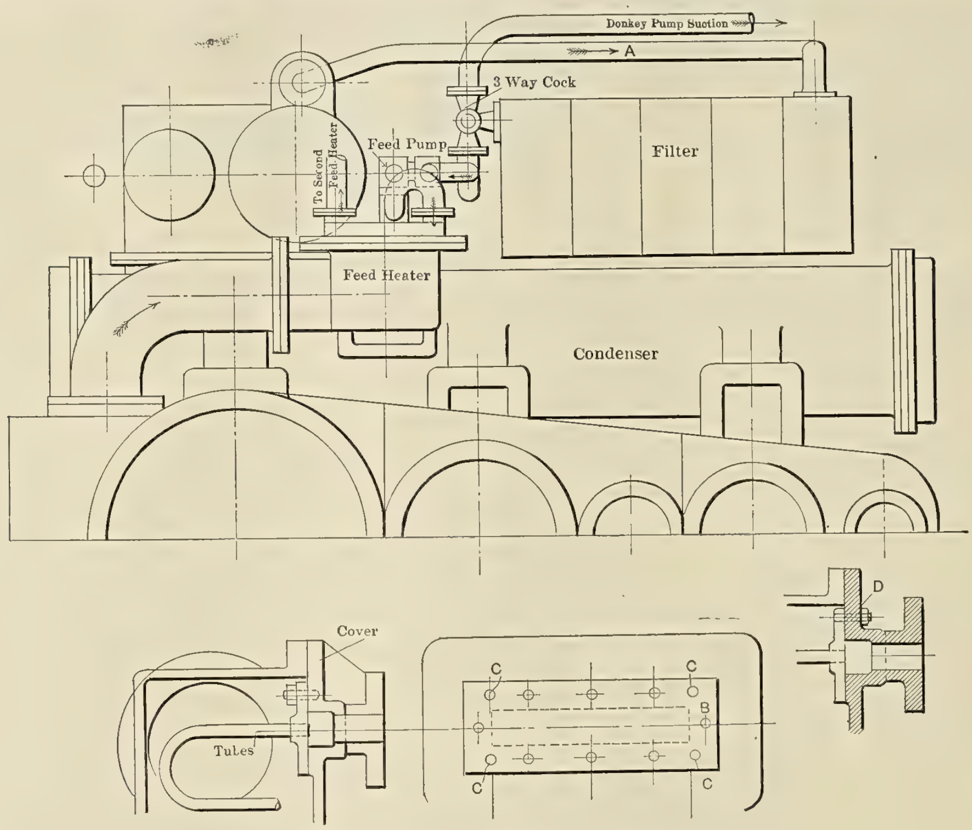
The following incident occurred on a trial trip of the tug *C*————. At the back of the engine a feed heater was placed between the low-pressure cylinder and the condenser; the feed water was forced by the feed pump through copper tubes, attached to two tube plates, which were bolted to the cover of the feed heater. The tubes in the feed heater were exposed to the exhaust steam and thereby heated. To get the feed water into the boiler at very high temperature, it was further heated in a second feed heater, into which steam from the intermediate pressure receiver was admitted. The water from the hot well was led into an oil filter, from which it was taken by the feed pump.

On the trial trip, some hours after the starting of the engine, it was seen that the water level in the boiler was falling, and that at the same time the pipe *A* gave much more water than at the beginning of the trial. The feed pump proved to be in good working condition, and it was then understood what the trouble was.

The packing material between the tube plates and the cover of the feed heater was too thick and had given way, so that the feed pump did not pump the water into the boiler, but forced it back into the condenser. This water was delivered again by the air pump into the filter, so that the pipe *A* gave too much water.

On stopping the engine the water in the feed pipe was all forced into the condenser, and on opening an air cock inserted on the air vessel of the feed pump the noise of the inflowing air was heard, which proved that the suggestion was true.

The engine was started again, and the feed water from the three-way cock pumped into the boiler by the donkey pump. After a half hour, in which the mishap was thoroughly discussed, the level in the gage glass was again examined, but the water was no longer visible in the glass.



LOCATION OF FEED HEATER AND DETAILS OF CONSTRUCTION.

The first thing was to draw the fires and then to hunt for the cause. It was soon found. The donkey pump forced the water into a valve chest, in which it could be led to the boiler, overboard and to the feed tanks. Between the overboard valve and its seat a small piece of stone had become lodged, so that the valve was not closed and the water was pumped overboard. The spindle was turned back and, on shutting, the valve was now closed very well, and the feed water pumped into the boiler, in the gage glass of which the level was soon visible again. Afterwards the boiler was inspected, but nothing out of the way was discovered.

When the cover of the feed heater was removed, the packing showed itself to have given way at *B*, where the pitch of the studs was rather wide. The studs *C* were added and the tube plates packed with very thin packing material. The heater has given no further trouble, although it would be better to put the studs in the tube plates, as indicated at *D*,

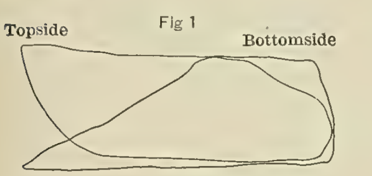
* We pay for these articles.

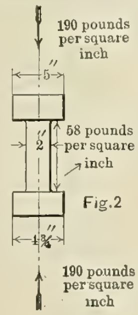
and have the nuts placed on the outside. Then it would be possible to tighten up the nuts after the whole apparatus had been warmed through. D. KOOIJMAN.

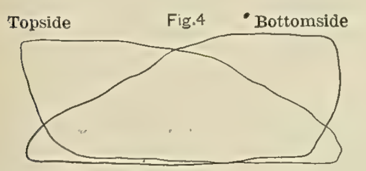
Indicator Diagrams.

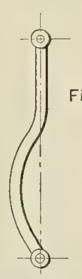
In recent issues of INTERNATIONAL MARINE ENGINEERING much has been written about indicators and indicator diagrams, therefore the writer thinks that the following will be found interesting.

From the triple-expansion engine of the tug *R*, indicator diagrams were taken on the trial trip, and the first high-pressure diagram is given in Fig. 1. This shows that the work exerted on the top side of the piston is much more than on the bottom side, and the cut-off on the forward stroke is much later than on the return stroke. Since, therefore, the compression at the top side was larger than at the bottom side,









it was understood that the valve had been set too low. But this seemed impossible, as before the valve chest cover was put on, the cut-off, compression and lead were all examined and had been found to be correct.

As seen from Fig. 2, the diameter of the upper piston of the high-pressure valve was 5 inches, the diameter of the lower one 4¾ inches, in order to make it possible to lift the whole valve with the valve stem without taking off the bottom valve chest cover. The boiler pressure being 190 pounds per square inch, and the steam pressure in the second receiver 58 pounds per square inch, the action of the steam in the line of the valve rod is as follows:

Downwards:

$\frac{1}{4}\pi(5)^2\ 190 + \frac{1}{4}\pi[(4\frac{3}{4})^2 - (2)^2]\ 58 = 478$ pounds.

Upwards:

$\frac{1}{4}\pi(4\frac{3}{4})^2\ 190 + \frac{1}{4}\pi[(5)^2 - (2)^2]\ 58 = 420$ pounds.

Resultant force acting downwards, 58 pounds.

The weight of the valve plus valve rods being 104 pounds, the resistance to be overcome when the valve is moving upwards is friction of valve plus 58 plus 104 pounds. When moving downwards, friction of valve minus (58 + 104) pounds, the difference being 2 (58 + 104) pounds = 324 pounds.

The valve was provided with solid packing rings, the friction of which was very much due to the fact that they fitted too closely in the valve bushes. The reversing gear was of the Bremme type, and the cast steel eccentric rod (Fig. 3) had been bent by the great forces acting on it. Whn the valve was moving upwards, the deflexion was more than when downwards, the resistance being larger in the first case. The result was that the eccentric rod became ¼ inch shorter, so that the valve showed itself to have been set too low. The cover was taken off, the valve set ¼ inch higher, and more oil was given to the engine. The new diagram (Fig. 4) showed that the difficulty had been overcome. No further deflection of the eccentric rod was indicated by the diagrams.

Probably the rod had been bent during the first revolutions of the engine after starting the first time, as no oil could be given to the rubbing surfaces, and much core sand, which was left in the steam ports, was blown in, which augmented the friction. D. K.

Complete Breakdown of a Low-Pressure Engine and Repairs to Same.

The following disastrous accident occurred aboard the steamship *Warfield* several years ago in mid-ocean, en route to Auckland from San Francisco. The ship had encountered extremely bad weather, which lasted about ten days, and the engineers on watch could never at any time leave the throttle, the pitching of the vessel was so great. At times the entire propeller would be exposed. Nevertheless, aside from the disagreeable conditions in general everything apparently was working well.

However, on the last day of the storm, with the second engineer on watch, the independent feed pump suddenly began to slam, owing to the plunger packing being worn out, consequently the engineer had to leave the throttle a minute in order to start the donkey feed pump. He had pulled the throttle down enough to check the speed of the engine considerably, but while he was away from the throttle a terrific pitch of the vessel brought the propeller out of the sea. The engine raced at about twice its usual full speed revolutions, and before the engineer could get back to the throttle one of the low-pressure crank-pin bolts sheared off at a point just below the nut and dropped out into the pit. This immediately opened the brasses on that side, and on the next revolution the other bolt snapped, freeing the connecting rod from the pin. As the valve was then in a position admitting steam to the bottom of the piston, it caused it to shoot up against the cylinder head, splitting it in two; also ripping several studs out of the cylinder. The next instant, before the engineer could reach the throttle, the loose engine received steam on the top side and made a violent down stroke. Here is where the greatest damage was done. The foot of the connecting rod got in the path of the turning crank and was jammed hard against the column, breaking and cracking large pieces out of it until it reached the base of the column. Here it stopped, but the crank and piston, still with power behind them, buckled the entire cross-head between the guides, bending the piston rod where it enters the cross-head block. This cracked both guides and columns, and the foot of the connecting rod carried away a large part of the column base, getting bent itself by the crank. This damage was all done in about two revolutions, so quick, in fact, that the engineer did not have time to stop the engine in order to prevent it.

It was impossible to consider drifting until help could arrive, so the debris was cleared away and temporary repairs attempted, so the ship could proceed, using the high-pressure engine. Without the low-pressure engine, however, nothing could be done, as the air and bilge pumps were worked from the low-pressure cross-head and beams. The ship was still pitching, which greatly added to the danger of a general collapse of the disabled engine.

Notwithstanding these dangerous conditions, repairs were started. The jacking engine was engaged to the turning gear, preventing the action of the sea from partly turning the

shaft. The removal of the connecting rod was next attempted. This was jammed so hard in the cross-head and column base that the greatest difficulty was met with in its removal; the work took about fifteen hours.

The task of freeing the shoes from their buried position in the guides, and on a bent piston rod with bent cross-head bolts, was still greater, considering the few appliances that were on hand. However, after almost twenty hours' work, it was also cleared.

The cracked cylinder cover was next lifted and lashed to the other cylinders, with the intention of lifting the piston and removing the rod. This was accomplished by a 5-ton triplex block hung from the overhead track. The nut was already slack, as the piston was driven over the taper about $\frac{1}{4}$ inch, so no trouble was met with here. However, when the removal of the piston was attempted, it was found that it was forced on the rod so hard that ordinary means of taking it off would be of no value. It could not be drawn out with the rod, as the bent cross-head end prevented it, so a fire was built on the piston, with the expectation that it would expand enough, allowing the rod to be hammered out and taken from the bottom end of the cylinder. The seas had abated somewhat by this time, permitting greater progress, and the shoring of the engine was commenced. Heavy timbers were taken from the cargo and brought into good service. From the side bunkers and after bulkhead these timbers were placed against the cylinder. Similar timbers shored up from the bed, etc., also from the overhead beams. All this shoring held the cylinder and columns in a very secure position.

Next, the work of making a cross-head was started. This was easy enough, as spare shoes were aboard and all that was needed was to bolt them on the cross-head block, although side guides had to be made. Four pieces of flat iron about 3 inches wide and 1 inch thick were found and then bolted on the sides of the shoes, preventing the cross-head from any possible side-play.

The connecting rod had not received serious enough bending to necessitate straightening, and it was used in its bent form. Both cross-head and pin brasses were still in fair condition, suitable for use at least. Spare bolts were aboard and in due time the rod was connected up with the cross-head and crankpin. The low-pressure valve was removed from its stem, and the admission ports plugged tight with hard wood.

When everything was in readiness the engine was turned over by the jacking gear; everything apparently moved all right. Steam was raised to about one-half full pressure and admitted to the high-pressure engine, which worked all right, except for a groan at every revolution, owing to the strained shaft being partly out of line with the engine. This caused the shaft journals to heat considerably. After slacking all the journal nuts, however, they worked better.

After running under reduced speed on the second day, the boilers showed a salt saturation, consequently we had to stop again and examine the condenser. On opening same several tubes were found leaking excessively. In a few hours we were under way again, with better conditions.

For five weeks the ship steamed with "one leg," and when port was reached the crude repairs were still intact. However, the entire engine had to be dismantled and a new one installed, although great credit was given for the repairs made and the durability of same in lasting five weeks without any signs of giving out. F. J. W.

Replacing the Propellers of a Twin-Screw Steamship without Docking the Vessel.

While crossing the Pacific Ocean from Japan to the United States recently, the British steamer *Bellerophon* of the Blue Funnel Line lost two blades from her port propeller. Two spare propellers were carried on board, but, as they were of different pitch from those in use, it was necessary to unship both the latter and adjust the two spare ones. Arrangements were made to place the vessel in the Puget Sound navy drydock, but before doing so an attempt was made by the chief engineer and his assistants to carry out the work without docking the vessel.

The *Bellerophon* is a twin-screw steel steamer of 5,727 gross tons, built in 1905 by Workman, Clark & Co., Ltd., Belfast, Ireland. She is propelled by two triple-expansion engines, having cylinders 23, $38\frac{1}{2}$ and 65 inches in diameter by 48-inch stroke. To carry out the repairs she was put down by the head by filling her forepeak and No. 1 hold full to the main deck, and No. 2 hold to a depth of 11 feet. This brought the stern out of the water, with both propellers clear, when scows were brought alongside and the work of replacing the propellers carried out. After the new propellers were in place the water in the forward part of the vessel was pumped out and she soon came to an even keel. The entire job was carried out at slight expense by members of the crew within five days.

Raising a Sunken Steamer.

The steamer *Milan* of about 850 tons register, ladened with 2,000 tons of coal, and about to proceed to sea was passing through the lock pit at the Alexandria dock, Hull, when she collided with the quay wall. The starboard bow of the vessel struck the wall, not with a hard blow, but with one which would easily have been warded off by a fender. As it happened, however, the anchor became wedged against the quay wall and pierced the plates below the waterline. The captain decided to put back into dock and wait until daylight in order to ascertain the extent of the damage, as it was then about 3 a. m., and not being aware that anything really serious had occurred, the crew turned in, but about 5 o'clock it was discovered that the vessel was slowly sinking. The pumps were set in motion, but they were found to be insufficient to cope with the inflow of water. The ship settled down by the stern and the crew were forced to abandon her. Finally, at about 7:30, she sank until only the masts, funnel and bridge were visible. Some of the hatches were burst off as she settled down.

VIEW OF THE SUNKEN STEAMER.

The vessel lay in about 29 feet of water and had to be relieved of her cargo before she could be raised. Divers

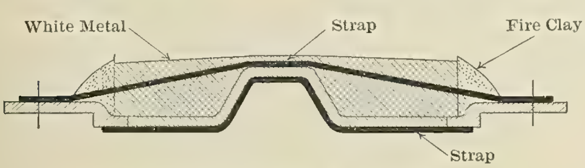
were set to work for some days previous to the attempt to raise the vessel, patching up the hole, which had caused her to founder, and plugging up all other inlets. The sides of the forward deck were built up with timber, canvassed and battened, and the hatches and skylights were also covered securely to facilitate the work of raising the vessel.

A salvage steamer was placed alongside to supply the necessary steam for working the pumps, and after the level of water in the dock had been lowered about 4 feet, pumping was commenced. Four pumps were employed, two amidships to deal with the water in the engine room, and one forward and one aft. The forward part of the vessel was pumped out first, and afterwards the pumps at the after end were started. The vessel rose rapidly and within a few hours was again afloat. She was then placed in drydock for repairs.

J. F.

Repairing the Cover of a Ballast Donkey Pump.

An interesting experience, which occurred on board a ship at a time when it was due to go to sea, may be of interest to your readers as illustrating the kind of temporary repair which is necessary in the event of an unforeseen accident. The particular instance occurred in connection with the pump cover of a ballast donkey engine. There happened to be a flaw in the piston rod, close to the neck of the cross-head, and as the pump was kept working for some days without cessation, even day or night, the strain was too much on the rod, and it snapped off short. The result was that the piston



DETAILS OF REPAIRS TO COVER OF A BALLAST PUMP.

traveled up further than its stroke, and came into violent contact with the cover. The blow was so struck that it broke the cover round the inside of the flange, the cover coming away in two pieces, leaving the flange intact. Fortunately, there was on board a piece of iron that was suitable for making a new rod, so that this part of the difficulty was overcome fairly speedily. As, however, the original cover had been raised in the center, or dished out, in order to allow the end of the rod to work up into it, it was impossible, without a great deal of trouble, to make a new cover out of a piece of plate, which would have been the usual course to pursue. It was also impossible to get another complete pump cover cast in the time available before the time of departure of the ship, so that a much more risky and temporary repair had to be resorted to.

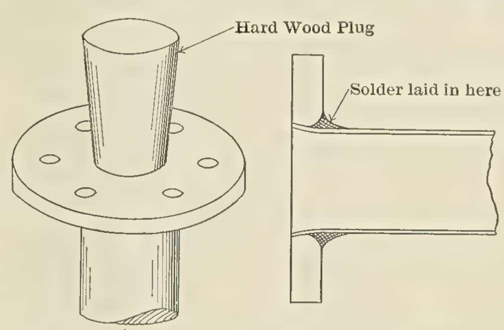
With the aid of some red putty and cement, the pieces of the cover were stuck together so that they were secured in their proper places. A piece of flat iron, 1¼ inches wide by ⅛ inch thick, was cut and bent to take in the broken pieces, and it was riveted on to the under side of the cover. Another similar piece was made to fit over the outside of the cover, and to pass over two of the cover studs. When the cover was screwed down these straps drew the broken parts together tightly, and after the cover had been put into place and jointed down, a strip of tin was placed around the outside of the broken parts, in order to form a kind of tray, and inside this fireclay was built up so as to form a solid mass. The whole repair was then run up solid with white metal, the general appearance of the repair being as shown in the sketch. Although this repair appears somewhat unorthodox, it was found in operation to be quite satisfactory. The pump was running nearly every day for three months after the date of repair and before a new cover could be obtained, and not the slightest leak of steam was apparent.

F. B. Foster.

Fractured Lead Pipes.

It is rather astonishing that the usual sea-going engineer knows very little about plumbing. The usual method which such a man employs, in order to repair a fractured lead pipe, is to take a piece of canvas, smear it over with white lead, and bind around it with marline, until such time as the ship shall arrive home. When the boat gets back into port, the plumber who is called in to effect a permanent repair has every reason to indulge in a quiet smile when he takes his knife to cut off a fathom or two of marline and a yard of canvas in strips in order to find a ¼-inch hole.

That such a subject may be mentioned with advantage is shown by the fact that it is no unusual thing for engineers to take the prong of a file and drive this into the bilge suction



pipe in order to see whether the pump is drawing. If such a thing has to be done it is just as well to use a small gimlet or pricker, as this makes a clean, round hole. It does not bulge the pipe in and the hole can be stopped up again with a small wood block. Where, however, a hole has been made, either accidentally or purposely, it is as well that engineers should know how simple it is to do a little piece of plumbing. It does not make much difference where the pipe is broken, whether in the neck of the flange or in the length of the pipe, or even if the flange is off altogether. To take the worst example, suppose that the flange of a lead pipe has come away altogether. The hole in the flange should be rasped out in order to admit the pipe, and the latter should be allowed to come flush with the flange. When this is the case, a tapered hardwood plug should be driven into the pipe, in order to expand the same into the flange, as shown in the first sketch. It is then necessary to scrape the parts thoroughly clean ready for the solder.

In order to make a kind of solder suitable for this class of work, the best mixture is to take one part of tin to one and a half parts of lead. The block tin makes the strongest possible job, but if there is none of this on board common solder will answer the purpose, using tallow or resin as a flux. The solder should be melted in a ladle and poured around the neck of the flange, as shown in the second illustration, finishing off the run solder with the smooth side of a piece of corduroy lamp wick. The lead flange and the pipe end should, of course, be slightly heated before soldering, in order to get good running of the solder, and by rubbing a mixture of lampblack and size on the parts which it is not required to solder, it will be found that any of the metal which has escaped on to such surfaces can be very easily rubbed off. It will be found that the directions given above will suit any repair to lead pipes which is likely to be found on board a vessel at sea.

Frank Robertson.

Trouble with the Pump Links.

On overhauling the engines of a tramp steamer after the pum links had been adjusted and nicely swung, the boat had a run of twenty-four hours to the next port, and it was then found that the links rattled most violently. When the ship had been taken into port the links were taken down and trammeled. It was then found that the feed-pump end was a good bit down and needed lining up. This involved rather a troublesome job, in order to get the links hauled up out of the brasses. The floor of the bunker came so close down upon the links that there was not sufficient room to get a pair of blocks up into position, so that it became necessary to cut a hole in the bunker floor. When this was done a shackle was put through the hole and provided with a bar, which spanned the hole and rested on the bunker floor, thus taking the weight of the shackle and everything which it had to support. The links were then placed on the top stroke, and in this position were made fast with slings to the roof. Then the cover and the top brasses were taken out, and the engine was turned on to the top center. This lifted the links out of their bearings, and it then became possible to get the bottom brasses out. A liner of the required thickness was then put under the brasses, and after these had been put back and the bearings adjusted, it was found that the knock had been entirely done away with.

Opening Out an Injection Valve with the Ship Afloat.

It is not often that the task is attempted of opening out an injection valve on board a vessel while the ship is floating freely in the water, as it is rather a risky kind of job, and most engineers are not altogether anxious to try such an expedient. It is, of course, preferable that when such work is to be done the boat should be dry-docked. But it occasionally happens that trouble occurs with the valve in some foreign port where there is no dock and no suitable position where the vessel can be beached.

In one instance the trouble which arose was that a pin was broken on the main injection valve spindle. This valve was cast with a double eye, and the spindle was fitted into this and held by the pin. When the pin was broken the valve then became a non-return valve. It would have been impossible to proceed upon a long voyage in this condition, as in a seaway the jolting up and down of the valve would very soon have caused trouble. In every probability it would first have broken away the end of the spindle, thereby increasing the injection of water, and in time it would most likely have meant the loss of the valve altogether.

In order to repair this defect the work was carried out in the following manner: It was known that the size of the connecting pin lost was ⅝ inch in diameter, and a second pin to this dimension was therefore made ready. In addition, everything else which could be foreseen was prepared, such, as for example, a new joint for the cover, etc. After this the pipe joint leading to the condenser was broken in order to allow the water to run into the bilges. A piece of strong canvas about 10 feet square had been obtained, and a line was fixed to each corner; the spot over the side was marked where the sea inlet to the injection was, and two men were told off into a boat, with orders to sink the canvas down to about the position where the valve was. At the same time two engineers were placed at the valve in the engine room, leaving a man on deck to pass the word from the boat to the engine room, or *vice versa*.

When all preparations were made and everything was ready the valve was quickly opened full out, and the water rushed through the sea inlet into the injection pipe and through the broken joint into the bilges, until the pressure of the water on the outside forced the canvas against the inlet grating. As soon as this had occurred the engineers in the engine room knew of the fact because, with the exception of a slight trickle, the inrush of water was stopped. A few minutes were then allowed to see if the canvas would hold tight; this was fortunately found to be the case, and as soon as this was ascertained the valve cover was lifted as quickly as possible, the new pin fitted and the cover replaced.

This repair may be regarded as a somewhat daring operation and, of course, it can only be conducted in perfectly calm weather and when the ship is light, otherwise there would be danger of the surge of water outside lifting the canvas flap, or if the boat is deep down in the water the head of water at the grating would probably pierce the canvas shield. If, however, this is done with care the procedure is quite safe and may save a heavy expense in dry-docking the vessel.

ECONOMY.

A Hint on Steering Gear.

Except on the largest boats the steering gear is very often neglected at sea, inasmuch as the engineers on board the vessel appear to think that the function of keeping it in proper working order is out of their department. They prefer to trust to the makers of the machine to send their own fitters to overhaul the gear on arrival at port should any defects occur.

This is, of course, a most unwise policy, and it is difficult to account for it unless it is owing to the fact that most of the steering engines are built in a very compact form and the parts are therefore difficult to get at. Unless specially accustomed to that class of work the average sea-going engineer would rather leave the matter alone so far as possible.

It will, of course, be understood that the valves used, in order to give steam to the pistons, are themselves piston valves. About the most puzzling job on the steering-gear engine is to find the leads of these valves, inasmuch as the cylinder is too small to examine, either by observation or touch, in order to measure the steam or exhaust ports. The rest of the overhaul of the steering gear is fairly ordinary; the following is therefore a useful hint as to the best way of finding the leads of these valves: Take a strip of paper, and push this into the cylinder so that it passes right through to the other end; then press with the finger or rub along the paper with a blunt stick and withdraw the paper. On properly measuring the marks left on the paper the size and position of these ports will be obtained. This, although a very simple hint, will probably save considerable time and labor.

Oil Ways in Small Bearings.

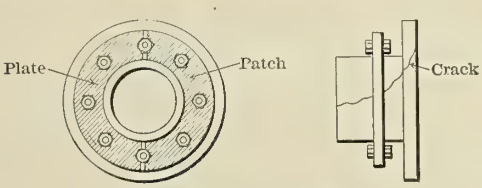
Although at the present time marine engine builders have, as a general rule, crystalized the experience of sea-going requirements into definite design of a high-class order, there yet occur cases in which small improvements are found to be necessary by the engineers on board a ship when they take the vessel to sea. One of the most common causes of trouble in a boat which is just out for its first run, is that the oilways in the small bearings are sometimes insufficient for their purpose. When the job is turned out from the shops, oilways are cut into the top half of the bearings quite corectly, but very often it is found that there are none at all in the bottom half. In such a case, the lower portion of a pin, which does not completely revolve, but simply oscillates to and fro through a certain arc, is found to be running quite dry, inasmuch as too much trust has been placed in the possibility of the oil working down from the top half to the lower bearing surface. In some instances the bearing brass and pin are very badly

scored, more especially in the case of the top end pins of connecting rods. It is not advisable in such cases to thin the lubricating oil sufficiently to penetrate down to the bottom brass, as it then becomes too thin to be of any great service in lubricating, and it is better to take the bottom brass out and cut an oil channel down each side of the brass nearly to the middle. In this way the oil is carried round to the bottom half oilways as the pin moves in its half circle, and it is astonishing to note the difference that is made in the life and running of both the pin and the brass. This point is worth the attention of all engineers in charge of a ship which they are taking out for the first time, as it will save a lot of trouble if a preliminary overhaul of the small bearings is made before any chance for trouble has been given. EXPERIENCE.

A Broken Stern Gland.

It sometimes happens that in spite of every care and precaution which is taken in effecting renewals and repairs the attempt to get over minor trouble leads to a much more serious complication, and when this happens a considerable amount of resource is necessary in order to put matters straight again. An example of this may be given: In a certain twin-screw ship it was required to put a turn of packing in the starboard stern gland while the vessel was afloat, as it was found that the gland was leaking rather badly. In order to accomplish this a diver was sent down outside the vessel, and was successful in stemming the outer end of the tail shaft before the gland was slacked back.

When this was accomplished two turns of packing were drawn out of the gland, and an attempt was made to get three turns of new packing in. This was, however, too much for



REPAIRS TO A STERN GLAND.

the gland, as while tightening it up too much strain was put on the nut, and the gland broke in two pieces. The illustrations show the nature of the fracture, from which it will be seen the crack went right through the middle of the gland. It was necessary to repair this in place, as there was not sufficient time to enable the engineers to get a new gland made before the ship sailed.

In order to accomplish this a narrow band was put round the barrel of the gland, as shown in the second sketch, in order to draw the broken parts of the gland tightly together. The next step taken was to get two pieces of ¾-inch plate to cover the flange of the gland, and these plates were drilled so as to go over the studs. In this way the gland was secured both on the flange and on the barrel, and in this position the gland was screwed up and made tight. So successful was the repair that the ship was taken to the Cape and back to Southampton before she was docked in order to have a new gland put in.

Bending Pipes at Sea.

It is not a very easy matter to bend pipes at any time without proper appliances, and sea-going engineers as a rule have not a very clear notion as to how to accomplish this work if they are faced with trouble of such a character. It is not included in their work on shore, as it is usually left for plumbers or small steam fitters. A knowledge of a few ways of doing this work is therefore very useful; as, for example, in cases where it becomes necessary to fit up a speaking tube, say, between the deck and the engine room or from the chief's berth to the engine room. A speaking tube of this nature may be made from old condenser tubes, and this becomes quite easy if the engineers know how to bend such tubes to any required shape.

This is done by filling up the tube with sand and blocking up the ends. If no sand is available, resin, which is usually carried on board a vessel, will do instead. When the pipe is filled it can be bent to any shape, and if it is not too thick in diameter it may be bent cold. Iron pipes above 1 inch in diameter may be bent without sand if care is taken to have the part to be bent maintained at a good red heat. It is hardly necessary to say that if the pipe is not filled it will usually go flat at the bend and have a very bad appearance, and in the case of condenser tubes they will break or kink.

The illustrations show the way the piping becomes distorted if it is bent without an internal filling. In some cases a very

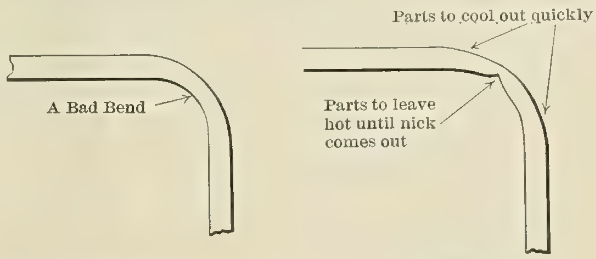


FIG. 1. FIG. 2.

nasty nick is obtained, as shown in the second illustration. If this should occur in an iron pipe, a method of taking this out again if the pipe is not fractured is as follows: The whole bend should first be heated to a good, red heat, and this cooled down all over except immediately at the nick. The part which is left hot will then come out to its original position. The second sketch shows the parts which have to be cooled and left heated, respectively. J. H. SMITH.

Hot Thrust Bearings.

In a new ship it was found that the thrust was running hot, and a considerable amount of attention had to be paid to it. It was attributed in the first instance to the way in which the cargo was distributed throughout the ship, as it was thought that the load had disturbed the line of shafting running from the engine to the propeller. In order to minimize the difficulty water was run on to the thrust shoes in order to keep them as cool as possible, and in addition the trough under the shaft was kept full of oil, so that the revolving collars dipped into the oil, and so lubricated themselves. In spite of all this, however, the thrust still ran hot, and this presented a problem which was not satisfactorily solved until after twelve months' continuous trial. It was at last decided, however, to cut on each of the eight collars four oilways on the headway side. These oilways did not run right down to the shaft, but very near to it, as shown in the sketch, so that they formed four radial pockets for oil. When the collar came round each time with the shaft these pockets dipped into the oil and water in the trough and carried some of the mixture round with them. It enabled the bearing surface of the thrust to be lubricated practically throughout its whole width, instead of, as before, at the circumference and such points as those to which the oil penetrated. This increased lubrication device effectively stopped the heating up of the thrust altogether.

GEORGE HALSEY.

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Turbine Propulsion.

Recent developments in turbine propulsion, as reviewed elsewhere in this issue, indicate a continual search for some means whereby the usefulness of the marine steam turbine can be extended to all classes of vessels and all conditions of service. At present the inherent advantages of the turbine can be realized in practice only to a limited extent, and, notwithstanding the widespread popularity of this type of engine, the enormous installations that have been made, and the spectacular speeds that have resulted, its field is still restricted to naval vessels and certain special types of merchant ships.

The pre-eminence of the turbine for naval work is undisputed. All recent warships in the British navy and many in other navies are so engined, and the magnitude of this work can only be realized when it is considered that there are now either actually built or contracted for 2,000,000 brake-horsepower of Parsons turbines for the British navy alone. The requirements which are peculiar to warship machinery, such as the minimum limitations of weight and space; the necessity for keeping the propelling machinery well protected; the minute sub-division of the hull in the machinery space, and the demands on the engines for large and frequent variations of speed, and for economical working at a low or cruising speed as well as at full speed, are more satisfactorily met by turbine machinery than by any other type. Not only this, but the smoothness of working, the absence of confusion in the engine room, the ease of handling and minimum amount of repairs, all have served to place the turbine high in the regard of the marine engineer; and we have yet to come across the man who has had charge of turbine machinery who is dissatisfied or prefers to go back to the reciprocating type.

Of course, turbines would never be justified if their economy did not compare favorably with that of reciprocating engines. In this connection it may be stated that the average steam consumption of the three battleships of the *Bellerophon* class is said to be 13.01 pounds per brake-horsepower per hour for the turbines only, with an average steam pressure of 147 pounds per square inch gage at the high-pressure turbine. In the *Indomitable* class of battle-cruisers, where the turbines are of much larger size and run at a slower rate of revolution than those of the battleships previously mentioned, the average consumption of steam at full power for the turbines only is said to be 12.03 pounds per brake-horsepower per hour, with an average steam pressure of 123 pounds per square inch gage at the high-pressure turbine. Results such as these certainly justify the turbine from the point of view of economy.

Successful as the turbine has proved in meeting the requirements for warships, it has made but little impression on the great bulk of merchant shipping. The reasons for this are well known and need not be enumerated here. This is the problem which is now engaging the attention of marine engineers to the exclusion of nearly everything else, and the time is probably not far distant when it will be possible to drive the low-speed, single-screw tramp by a turbine engine with satisfactory economy. All schemes proposed to effect this are still in the experimental stage, and, so far, no practical results have been obtained to conclusively prove or disprove their value.

Of these proposals, that providing for electric transmission promises a saving in fuel and a reduction in the machinery weights and space; but the initial cost is high, and the system involves undesirable complication. A spur gear reducing mechanism is being given a practical tryout, and good results are promised. Similar expectations are entertained for an hydraulic reducing gear, consisting of a high-speed primary water turbine driving a slow-speed secondary water turbine. In view of this activity in the experimental field it is impossible to doubt that a speedy solution of this important problem will be forthcoming.

Experiments with Navigable Models.

Professor C. H. Peabody announces that the Department of Naval Architecture of the Massachusetts Institute of Technology is about to undertake important investigations concerning the propulsion of ships by aid of a navigable model about 40 feet long. This method of research has already been used in Great Britain in connection with the designs of the *Lusitania, Mauretania* and *Otaki,* where the proposed designs were carried out on a small, inexpensive scale and tested under approximately the actual conditions of service. The immediate problem which has been chosen for investigation at the Institute is the obscure one of the added resistance due to the action of the propeller working in the wake of the vessel.

In order to take advantage of a successful series of progressive speed trials which were made several years ago by Professor Peabody, the experimental boat will be a one-fifth scale model of the United States steamship *Manning*. Having at hand the data obtained in the former progressive speed trials of this vessel, the results obtained with the model will furnish a certain basis for determining from model experiments what may be expected of full-size ships. The propulsive machinery of the model will consist of a gasoline electric generating set and a motor geared to the propeller shaft. This combination is convenient for experimental work, since the conditions can be controlled over a wide range and the measurements of power be easily made.

This method of research opens up a wide field of possibilities and leads us to expect that many of the abstract problems in connection with resistance and propulsion which have hitherto been obscure, as well as many of the concrete problems arising in the design of new vessels, will by this means meet with a ready solution.

Naval Matters.

Comparisons of the naval strength of the nations are seldom satisfactory, for the reason that so many factors can be included or omitted in the estimate according to the judgment of the statistician. A comparison by tonnage, however, is useful not because it necessarily gives the fighting strength of the navies, but because it represents the nation's naval resources. At the present time, the standing of the naval powers, according to the figures given by the Secretary of the Navy in his annual report, is as follows: First, Great Britain, 1,758,350 tons; second, United States, 682,785 tons; third, Germany, 609,700 tons; fourth, France, 602,920 tons; fifth, Japan, 400,368 tons. If the vessels now under construction were completed, the only change in the relative order of standing would be that Germany would take second place and the United States third, with France a close fourth.

In new naval construction speed is beginning to play a very important part. It was only a few years ago that sixteen or eighteen knots was considered a sufficient speed for a battleship. To-day battleships are not designed for less than twenty knots' speed and the advent of the large armored cruiser or, as it is sometimes termed, the battle cruiser with a speed of twenty-six or twenty-eight knots has made the matter of power one of the momentous factors in the design of warships. This increase in speed is, of course, due almost entirely to the advent of the water-tube boiler and the steam turbine.

In the matter of armament, the all-big-gun feature is still the predominating one in capital ships, and the endeavor to so mount these guns as to give the greatest possible broadside fire has led to the almost complete abolishment of the superstructure and a return to clear decks. The most striking feature of the modern armament of a war vessel is its greatly increased destructive power. The modern 12-inch naval gun is now effective at the maximum battle range which would be possible under normal conditions, and the high velocities achieved with this gun, together with the ease and rapidity with which it may be handled, have served to establish it very firmly as the main defensive naval weapon. That some advantage might be gained by using a gun of larger caliber is not denied, since a 13.5 or a 14 inch gun firing projectiles weighing respectively 1,250 pounds and 1,400 pounds would make vastly more destructive weapons. Furthermore, since a lower muzzle velocity can be used in such a gun the life of the gun is materially increased, and it is claimed that with the 14-inch gun, which has been designed for the United States Navy, the gun will be serviceable for about 300 discharges whereas the present 12-inch gun has to be relined after 80 or 100 discharges. The use of a larger gun would be a logical development in the modern battleship and is to be expected.

As to the placing of the main battery on a battleship three ideas seem to prevail, which may be termed the English, American and German. In practically all of the English *Dreadnoughts* the midship turrets are placed *en echelon* on either beam, with an opportunity for the guns of each turret to be trained on either broadside. In American designs all of the 12-inch guns are placed on the center line of the ship and all can be fired on either broadside. The German design, however, provides for turrets on the center line forward and aft and four turrets amidships, one on each quarter. These turrets are masked by the superstructure amidships, so that the guns can be trained on the single broadside only.

Considerable difference of opinion exists with regard to the secondary armament of battleships. England has taken the lead in discarding intermediate calibers, but this step has not been universally commended by designers of other navies. Satisfactory positions for the small guns are hard to find and the proof of an engagement is needed to settle this.

Progress of Naval Vessels.

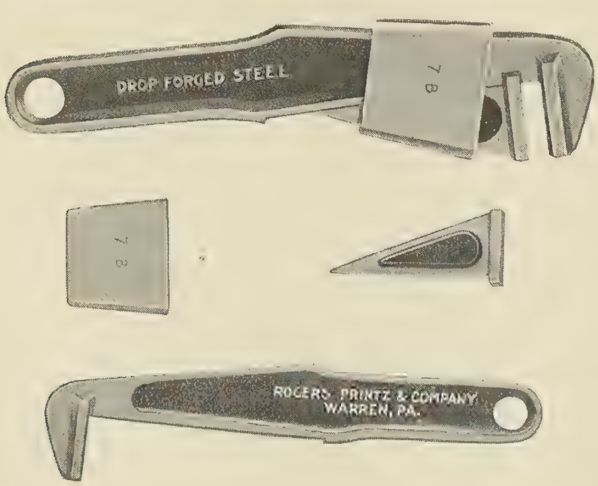
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Dec. 1.	Jan. 1.
BATTLESHIPS.					
Delaware ...	20,000	21	Newp't News Shipbuilding Co.	98.0	98.5
North Dakota	20,000	21	Fore River Shipbuilding Co..	97.5	98.0
Florida	20,000	20¾	Navy Yard, New York......	42.3	46.4
Utah	20,000	20¾	New York Shipbuilding Co..	54.3	58.2
Arkansas ...	26,000	20½	New York Shipbuilding Co..	3.2	8.0
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	1.7	6.0
TORPEDO-BOAT DESTROYERS.					
Lamson	700	28	Wm. Cramp & Sons.........	94.8	98.1
Preston	700	28	New York Shipbuilding Co..	99.7	100.0
Paulding ...	742	29½	Bath Iron Works............	53.5	59.8
Drayton	742	29½	Bath Iron Works............	46.8	54.3
Roe	742	29½	Newp't News Shipbuilding Co.	68.8	70.8
Terry	742	29½	Newp't News Shipbuilding Co.	68.4	70.7
Perkins	742	29½	Fore River Shipbuilding Co..	64.0	64.8
Sterrett	742	29½	Fore River Shipbuilding Co..	62.6	64.4
McCall	742	29½	New York Shipbuilding Co..	37.5	42.1
Burrows	742	29½	New York Shipbuilding Co..	37.5	42.1
Warrington..	742	29½	Wm. Cramp & Sons.........	55.6	58.0
Mayrant	742	29½	Wm. Cramp & Sons.........	56.5	58.8
Monaghan ..	...	..	Newp't News Shipbuilding Co.	4.7	7.4
Trippe	...	..	Bath Iron Works............	11.8	13.5
Walke	...	..	Fore River Shipbuilding Co..	7.9	9.9
Ammen	...	..	Fore River Shipbuilding Co..	10.4	10.9
Patterson ...	...	..	Wm. Cramp & Sons.........	5.1	6.7
SUBMARINE TORPEDO BOATS.					
Snapper	...	..	Fore River Shipbuilding Co..	99.3	100.0
Salmon	...	..	Fore River Shipbuilding Co..	87.2	90.4
Seal	...	..	Newp't News Shipbuilding Co.	30.8	34.1
Carp	...	..	Union Iron Works..........	27.4	35.6
Barracuda ..	...	..	Union Iron Works..........	27.5	35.3
Pickerel	...	..	The Moran Co.............	23.1	32.0
Skate	...	..	The Moran Co.............	23.1	32.0
Skipjack	...	..	Fore River Shipbuilding Co..	11.1	13.6
Sturgeon ...	...	..	Fore River Shipbuilding Co..	11.1	13.5
Tuna	...	..	Newp't News Shipbuilding Co.	9.9	12.3

ENGINEERING SPECIALTIES.

Arpeco Wrenches.

A new and extremely simple wrench is being placed on the market by Rogers, Printz & Company, Warren, Pa. These wrenches, as shown by the illustration, consist of only three pieces, and operate on the wedge principle. The three parts are the main handle bar, the shank or the lower jaw and the

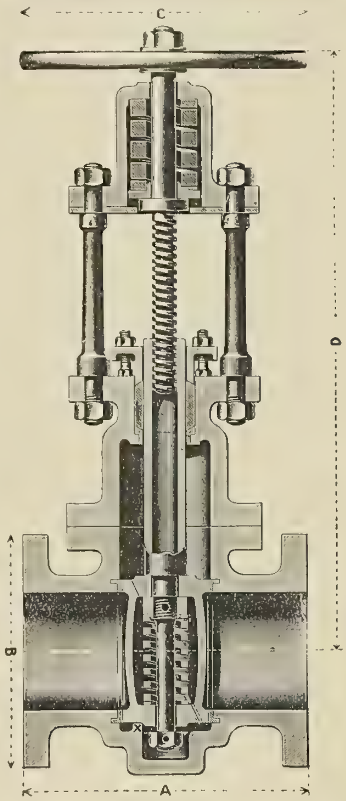


yoke or sleeve. The main handle is made from specially tempered drop-forged steel in the form of an I-beam, which not only gives unusual strength but also affords a good grip for the hand. The lower edge is also drop-forged steel of the same special quality and temper. The yoke or sleeve is cold drawn from specially made fine quality seamless steel tubing. The operation of the wrench is clearly apparent from the illustration. It is simply necessary to raise or lower the yoke or sleeve by the thumb of the hand which holds the tool, and a powerful grip can be obtained.

Turnbull's Patent, Excelsior, Parallel, Slide, Full-Bore Valve.

The valve illustrated, which is manufactured by Alexander Turnbull & Company, Ltd., Bishopbriggs, Glasgow, is claimed to give positive closing or shutting off of the steam at both the inlet and outlet faces.

The positive closing is obtained by forming the valve block in halves, constituting oppositely inclined planes sliding upon each other in dovetail grooves, thus introducing a wedge action when closing. The outlet half is secured to the spindle, leaving the inlet half free to move, due to the expansion of the spring until brought up by the nut at the end of the spindle. When in any but the closed position the two halves of the valve block are kept fully distended between the shoulder on the spindle



and the nut, due to the expansion of the internal spring (made of special non-corrosive metal), thus reducing the width of the block sensibly less than the distance between the seat faces. It is claimed that the internal spring, acting along the line of the valve spindle, and not at right angles to the valve faces, does not set up any abrasive or wearing action on the seats or faces. In closing, the block travels down until, when opposite its seat, the inlet half comes into contact with the stop, then the continued downward movement of the spindle and outlet half acting against and compressing the spring, sets up the wedge action, which positively closes both faces of the valve. In opening, the least upward movement of the spindle and outlet half of the block is assisted by the upward thrust of the spring, until the nut engages the inlet half of the block, when the valve block, being less than the distance between the seats, lifts easily without friction.

A New Reversible Marine Oil Engine.

Recently, at the invitation of Messrs. James Pollock Sons & Company, Ltd., of London, a number of the members of the Institute of Marine Engineers made a trip on a fishing vessel of the Swedish type equipped with a Bolinders reversible oil engine. The vessel was 60 feet long by 19 feet, with a depth of 9 feet. The engine was a two-cylinder, two-cycle, 80 brake-horsepower motor, with cylinders 12.99 inches diameter and

13.39 inches stroke, running at 325 revolutions per minute. This motor differs from the usual forms of reversible motors, in that the reversing action is effected by means of a valve gear instead of by compressed air. The engine also possesses the advantage in that the use of epicyclic clutches, or feathering propellers, is obviated for the ahead or the astern movements, and the engine can thus be adapted for high powers. The engine is designed to burn crude oil or kerosene (paraffin), and drives the vessel at a speed of about 8 knots. There is no separate compressor used for compressing the air for starting purposes, one of the engine cylinders serving for this purpose. The engine has a pump for providing water circulation and also a bilge pump. Forced lubrication is used throughout, and all the principal bearings have a small pump, driven from a common shaft.

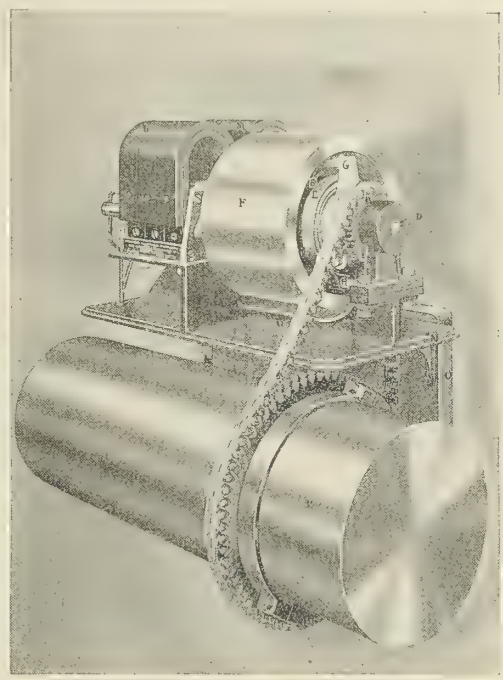
The Hutchison Marine Tachometer.

It is a matter of importance for the captain of a steamship to be able to quickly and accurately determine the revolutions per minute of the engines ahead or astern, and to know definitely that his signals to the distant engine room are understood and being obeyed instantly and correctly. When a squadron of warships are maneuvering or cruising it is of vital importance that the signals for definite ship speeds, as ordered by the flagship, be obeyed instantly. A vessel traveling 10 knots, with 72 revolutions per minute, is not doing 10 knots at 71 revolutions per minute. Therefore, such a tachometer as shows the instantaneous value of engine-shaft rotation must be accurate within at least 1 percent, and remain accurate. Every steamer has its most economical cruising speed, and it is a matter of saving coal to keep the engines at such revolutions per minute as will conform to this. It was with a full realization of the importance of this field that Miller Reese Hutchison, an electrical and mechanical engineer of New York, designed the Hutchison Electrical Tachometer to meet and overcome the difficulties previously encountered.

The Hutchison electrical tachometer consists of a magneto having a stationary armature and stationary poles. Between the pole pieces and the armature rotates a soft iron inductor, which, by varying the flow of the magnetic lines of force through the armature winding, generates current therein, which is led to the alternating-current voltmeter (calibrated in revolutions per minute of the driving shaft) through insulated wires. All joints are soldered and taped. The permanent magnets of the magneto are made of the best German steel, carefully aged and treated, to insure permanence and constancy of magnetism. There is nothing to get out of order and nothing needing attention. The voltage of the magneto is directly proportional to the speed of its inductor up to a certain maximum, and the scale sub-divisions of the indicator are hence equal. In practice, a plurality of indicators, placed at widely separated points, may be operated from the same magneto.

The application of the electrical tachometer to ship service necessitated several modifications in design, the principal ones being (1) twin generators, so as to show *direction* of rotation as well as rate. (2) Inertia compensators for angular variation of speed of driving shaft and (3) special form of indicators. Otherwise the description of the marine type will convey a good idea of the principle and construction of this new instrument.

Referring to the illustration, *P* represents the propeller shaft. Clamped around it is the split sprocket *A*. Rotation is imparted to the driving sprocket *B* by the Morse silent chain *C*. Sprocket *B* is loose, not keyed to the generator shaft *D*, but is simply rotatively mounted thereon. Two oppositely-coiled flat spiral springs *E-E′* transmit the rotation of *B* to the fly-wheel *F*, which is keyed onto shaft *D*, one end of each spring being attached to the sprocket *B*, and the other end to the fly-wheel *F*. Any irregularity, therefore, of rotation in *Be*, caused by variations in angular velocity of shaft *P*, is smoothed out by *E-E′*, so that the rotation imparted to *F* and *D* is a constant resultant speed. The springs are protected against strain or breakage from sudden reversal of *P* by radial arm *G* engaging pin *H* attached to fly-wheel. On the inside face of fly-wheel, at the end opposite from that occupied by *E-E′*, are cut gear teeth, so arranged as to engage pinions *J* and *K*, which actuate magnetos. Pinion *K* is keyed to the inductor shaft of its magneto *M*. Pinion *J* is not keyed to its shaft, but so mounted that when direction of rotation of main shaft is "ahead" the inductor of magneto *L* is in the exact rotative relation to its armature and pole shoes as that of magneto *M*. The current from *L* is therefore in phase with that from *M;* but when *P* is reversed in rotation, pinion *J* rotates idly on the shaft of magneto *L*, until it has traveled 90 degrees, at



which point it begins to drive the magneto. The result is that the inductor of *L* assumes an exactly opposite relation to its armature and pole pieces as obtains at the same instant in *M;* hence the current from *L* is 180 degrees electrically out of phase with *M*. The magnetos have two cycles per revolution of inductor.

Two wires run from *L* and two from *M* to each indicator. When running "ahead" the circuits are in phase. When *P* rotates "astern," one circuit is 180 degrees electrically out of phase with the other.

The indicators, or voltmeters, have two coils—the moving coil to which the pointer is attached and a fixed or field coil. The field coil is connected electrically to one of the magnetos, and the fixed coil to the other. When two magnetos are in phase—that is, when the shaft *P* is running "ahead"—the deflection is to the right, and indicates revolutions per minute "ahead." When they are 180 degrees out of phase the pointer is deflected in the opposite direction, or to the left, indicating revolutions per minute "astern." The faster the shaft *P* turns in either direction the higher the voltage generated, and the greater the deflection of the pointer calibrated to conform thereto. In the indicator designed for pilot-house use there is no iron, steel or other compass-deflecting materials in its construction, and it may, therefore, be placed in proximity to the compass without affecting same. This type is also used in the staterooms of the captain and engineer, so that these

officials may tell at any instant just what is going on in the engine room.

The engine-room indicator has a very long scale and prominent pointer. It may be read from a distance of 20 or 30 feet, and when placed in line of vision of the man at the throttle enables him to bring his engine quickly and accurately up to any desired speed.

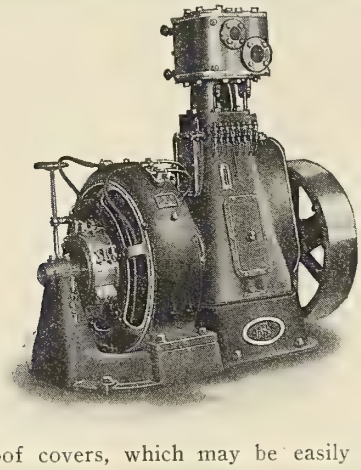
These instruments are manufactured by the Industrial Instrument Company, Foxboro, Mass. The first marine tachometer was placed on board ship about eighteen months ago, and it is claimed that it has remained untouched and in perfect calibration ever since.

A New Generating Set.

The generating set described below is specially designed for use in isolated plants, upon shipboard and in all places where a thoroughly reliable, high-grade, efficient, quiet-running generating set is necessary. It is the latest product of the B. F. Sturtevant Company, Hyde Park, Mass.

The set consists of a generator of either the six or eight-pole type, depending upon the size, attached to the same sub-base and direct connected to the new Sturtevant vertical single engine, known as class VS-7.

This engine is of the high-speed enclosed type, the reciprocating parts being entirely enclosed within the frame, which is provided with openings through the front, back and sides, of sufficient size and in just the right position to permit ready access for inspection or adjustment. These openings are fitted

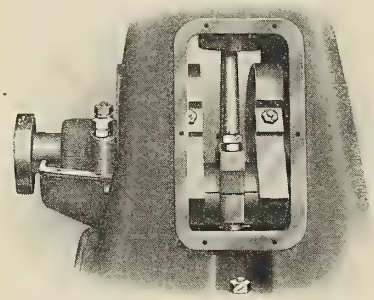


with dust-proof covers, which may be easily removed. A water-shed partition prevents the oil from the frame being carried into the cylinder and the water in the cylinder being carried into the frame. This water-shed partition, together with a piston rod stuffing box, are located in a distance piece, which separates the cylinder from the frame. Access to these parts is readily obtained through openings in the distance piece, even though the engine is in operation.

The lubricating system, of the gravity type, consists of a reservoir cast in the top of the frame, from which the oil flows to all bearings through piping equipped with sight feeds. All the oil not used flows into a reservoir cast in the sub-base. It is filtered through fine screens and forced to the top reservoir by a durable, efficient pump, located in the sub-base and entirely submerged in the oil. The engine may be run independently of the oil pump by filling the top reservoir through an opening provided in the frame, and drawing off the excess oil from the bottom reservoir through a drain cock.

A Rites inertia governor, placed in the balance wheel, regulates the speed so accurately that the variation between no-load and full-load is claimed to be not more than 1½ percent.

The generator armature is of the ironclad, two-circuit, ventilated drum type, and is pressed upon the shaft. The armature coils are form wound, and are thoroughly protected against oil and water. The commutator is made up of segments of pure, hard-drawn copper, insulated with amber mica, of such hardness that it will wear uniformly with the copper. These segments are secured in a steel ring, and insulated therefrom by rings of hard mica. Armature conductors, commutator segments and brushes are proportioned to give low-current density, thus insuring low temperature rise, high efficiency and



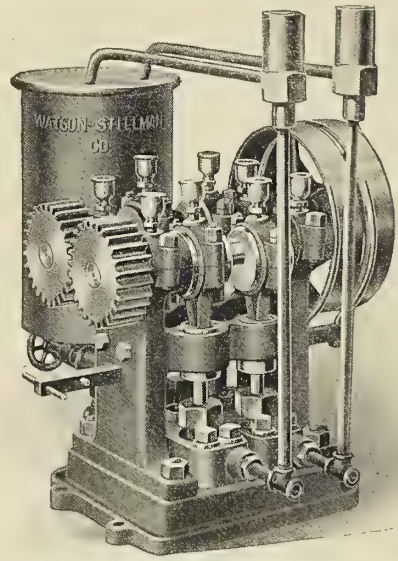
good operation. The brush rigging is arranged so that the brushes may be adjusted separately or may be adjusted simultaneously by revolving the brush ring.

The magnet frame is of cast iron, and is divided on a horizontal plane. The pole pieces are of wrought iron, and together with cast iron shoes are through-bolted to the frame. The field coils are made up in two sections, the compound winding forming one section and the shunt winding the other section. They are machine-wound and of open construction, to secure maximum radiation and ventilation.

Only the best material obtainable and the most careful and expert workmanship enter into the construction of these sets, which are thoroughly tested and subjected to the most rigid inspection before leaving the company's works.

A Small but Powerful Hydraulic Pump.

The four-cylinder, two-pressure line hydraulic pump illustrated represents a new Watson-Stillman type, by means of which one, two, three or four pressure lines may be served



independently of each other, but from a common reservoir. Each pressure line has a separate pressure chamber, safety valve and release line, and is served by a separate pair of cylinders (½ inch diameter by ½-inch stroke) having eccentrics set to give a continuous flow. It is claimed that any pressure up to 600 pounds per square inch may be delivered into any line, the limit in each instance being determined by the setting of the safety valve, which opens as the pressure tends to exceed the limit and lets the surplus liquid pass back

through the release pipe to the reservoir. Any pressure line can be thrown out of service entirely by opening the safety valve, in which instance all the liquid in that line pumps directly back to the reservoir.

The one, two, three and four-pressure line pumps are practically the same in design save for change in the length of the bedplate and the shafts to accommodate the required number of pressure chambers, cylinders, piston rods, eccentrics, etc., and may be fitted with an electric motor instead of the pulley shaft shown. These pumps are made by the Watson-Stillman Company, of New York.

OBITUARY.

George Thompson, superintendent-engineer of the Cunard Steamship Company, Ltd., died of pneumonia at Waterloo November 30. Mr. Thompson began his business life at Belfast as a premium apprentice in the engineering works of Messrs. Harland & Wolff. After completing his apprenticeship, he gained sea-going experience, and upon obtaining his extra chief engineer's certificate he returned to Harland & Wolff's and entered their drawing office. Later he was intrusted with the important duty of supervising the erection of engines for new vessels, finally becoming works manager. In June, 1903, he entered the service of the Cunard Steamship Company, Ltd., of which he became superintendent-engineer in 1904.

THE LATE GEORGE THOMPSON.

Correction.

In the last paragraph of the article describing the Sulzer Marine Diesel Engine, published on page 41 of our January issue, the cost of fuel per brake horsepower-hour should read .139d (.278 cent) instead of 139d ($2.78) as published.

At the annual convention of the National Marine Engineers' Beneficial Association, held in Washington, D. C., during the week of January 16, the following officers were elected for the coming year: President, William F. Yates; first vice-president, Art Hyde; second vice-president, W. P. Tindall; third vice-president, C. N. Vonsburgh; secretary, George A. Grubb; treasurer, A. L. Jones. The convention was well attended and proved a success in every way.

TECHNICAL PUBLICATIONS.

Accounting Every Business Man Should Know. By E. E. Garrison. Size, 5 by 7¼. Pages, 188. New York, 1909: Doubleday, Page & Company. Price, $1.20 net.

The aim of this work has been to lay bare to business men the whole structure of modern accounting from foundation to summit. Simply and briefly the author explains the principles of business operation and finance and clears away all obscurities. The author is well qualified through an extended and varied business experience to deal with the subject in the most thorough manner. It is undoubtedly true that this subject has been little understood by many men whose business relations demand an intimate knowledge of the subject, and this merely from the fact that the real values and purposes of accounting are hidden in a multitude of details and obscurities. Great length and much detail are avoided in this volume, but the treatment is complete and very clear. It is a book which every business man should find of value.

A Text Book of Navigation and Nautical Astronomy. By Capt. A. P. W. Williamson, F. R. G. S. Size, 5½ by 8½. Pages, 387. Figures, 163. London, 1909: J. Griffin & Company. Price, 7/6 net.

This book is a complete and reliable text-book for those who are studying for the Board of Trade examinations, as well as for general students. Both elementary and advanced work are given, and the method of solving various problems is fully explained and illustrated by means of diagrams and numerous examples. After treating the entire subject of navigation and nautical astronomy as completely as possible, the author gives in an appendix a number of examination papers with answers to the questions, together with the necessary tables for solving the problems, so that the student may obtain a fair idea of the requirements of the Board of Trade examinations.

Ship Construction and Calculations. By George Nichol. Size, 6½ by 9¼. Pages, 330. Figures, 239. Glasgow, 1909: James Brown & Sons. Price, 10/6.

This book is timely in that it is the first one on ship construction from the press since the promulgation of Lloyd's latest rules. The book is a general one, covering most of the problems met by ship superintendents, draftsmen, and shipyard apprentices. It is distinctly practical and up-to-date. In fact there are a large number of sketches of details which are not usually included in books on naval architecture. Beginning with the simple ship calculations, which are necessary to determine the buoyancy and stability of ships, the author then goes on to discuss bending moments, shearing forces, stresses and strains. This subject is gone into very thoroughly and a large number of curves of loads, shearing forces and bending moments are given for ships in various stages of loading. A large part of the book takes up various types of cargo steamers, and it is in this part that most of the details of construction are given. The latter part of the book contains such matter of value to a navigating officer, so that he may properly manage his vessel afloat. Calculations for stability, trim, rolling and loading and ballasting are given in detail.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

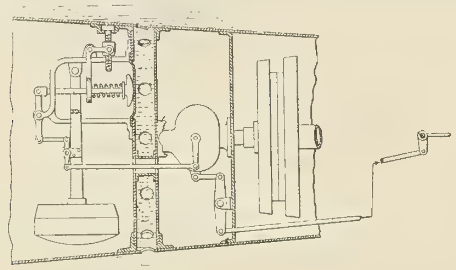
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

919,014. EJECTOR FOR SHIPS' ASHES. LUDWIG HOCHSTEIN, OF NEUMÜHLEN-DIETRICHSDORF, NEAR KIEL, GERMANY.

Absract.—This invention relates to those devices for ejecting ashes for ships which are operated by high pressure water or the like and the present novelty consists in branching the ascension pipes of the ejector toward both sides of the ship. At the branching point there is arranged a switching device by which one or the other of the branch pipes may be closed off as desired. Five claims.

933,083. DIVING GEAR FOR SUBMARINE BOATS. FRANK M. LEAVITT, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

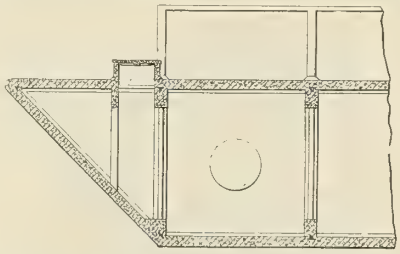
Claim 1.—A diving gear comprising hydrostatic controlling means, a source of power, a rudder and an interposed steering mechanism com-



prising a power-controlling device, controlled from said hydrostatic means, and a driven part connected to the rudder and propelled progressively by said power in either direction under control of said power-controlling device. Twelve claims.

933,314. CONCRETE SCOW. OSCAR F. LACKEY, OF BALTIMORE, MD.

Claim 4.—A boat comprising a concrete hull, a metal frame reinforcing the said hull, a plurality of concrete bulkheads provided within the hull, a plurality of compartments formed thereby, a deck formed



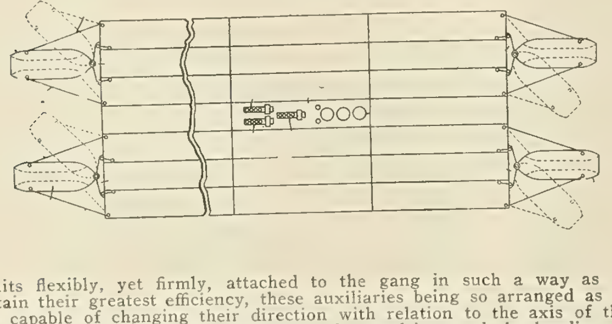
integral with the said hull, a plurality of ribs extended longitudinally of the said hull and deck, a plurality of posts formed at the juncture of the said bulkheads and ribs forming supports for the said deck. Six claims.

934,192. TORPEDO-TUBE. CESARE LAURENTI, OF SPEZIA, ITALY, ASSIGNOR TO SOCIÉTA ANONIMA FIAT-SAN GIORGIO, OF SPEZIA, ITALY.

Claim 3.—In combination with a torpedo tube, a cover for the mouth of the same, a connecting rod connected at one end to said cover, a traveling threaded member connected to the opposite end of said rod, and a fixed threaded member for actuating said traveling threaded member to move said rod to open and close the tube. Four claims.

936,336. SYSTEM OF RIVER TRANSPORTATION. JULIUS S. LANE, OF BROOKLYN, N. Y., AND JOHN L. MATHEWS, OF BILLERICA, MASS.

Abstract.—The invention consists in the combination with a gang or fleet of barges rigidly attached to each other, of propelling auxiliaries or



units flexibly, yet firmly, attached to the gang in such a way as to attain their greatest efficiency, these auxiliaries being so arranged as to be capable of changing their direction with relation to the axis of the fleet, the power, speed and direction of propulsion, and the heading of the auxiliaries being each independently under the control of the pilot of the fleet from a central pilot house. Twelve claims.

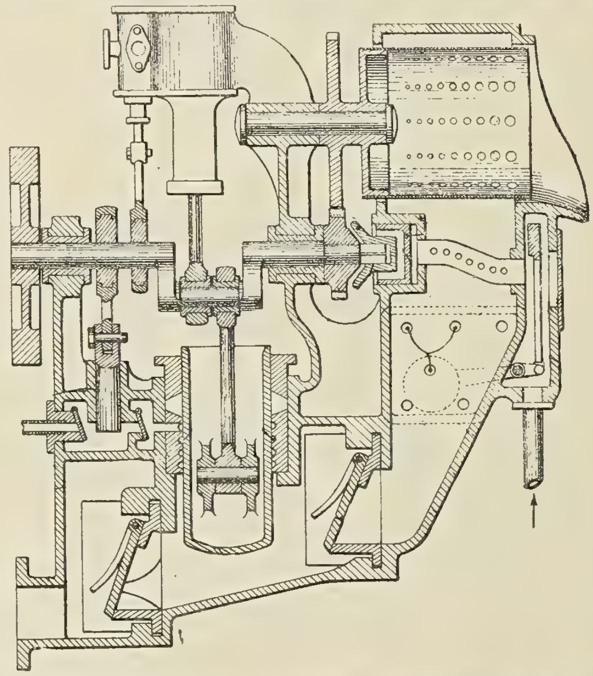
935,413. LOCK FOR DAVITS. WILLIAM J. RYAN AND LEWIS TANNING, OF NEW YORK, N. Y.

Claim 1.—The combination of a revoluble davit stem, a member mounted thereupon and provided with a slot; a dog provided with a portion for entering said slot in order to hold said member and consequently to hold said davit stem, and means controllable at will for shifting said dog from one position to another. Seven claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 4 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

6,513. ASH-REMOVERS FOR SHIPS. H. THIRION, PARIS, FRANCE.

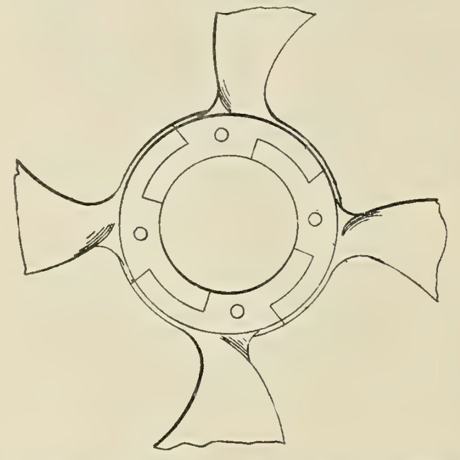
The ashes are admited through perforations in the drum into a mixing chamber for the purpose of mixing with the spent fuel and water, when the said drum is revolving. The mixing is automatically regulated by the pressure of the water, which flows through pipes into



the tank. This pressure acts on the piston and maintains the parts coupled and revolves the drum. When the flow of water diminishes the pressure on piston is reduced, the drum stops and the quantity of ashes admitted to the mixing chamber cannot exceed that of water. An auxiliary pump is provided which feeds water through the ring into the cylinder.

1011. CONSTRUCTION OF PROPELLER-BLADE CENTERS AND ADAPTABLE TO ALL CLASSES OF PROPELLERS FOR OCEAN-GOING PURPOSES. W. H. IRELAND, HANDSWORTH, BIRMINGHAM.

According to this invention, propellers are so constructed that any one of the blades and its part of the boss can be readily removed when



required, and for this purpose the boss is built of segments, to which the blades are cast direct. The segments are provided with flanges adapted to engage with the flanges on the adjacent segments, bolts passing through the overlapping flanges to secure the sections.

19,293. CONSTRUCTION OF BOATS AND SHIPS. W. H. FAUBER, NANTERRE (SEINE), FRANCE.

In hydroplane boats, the members constituting the bottom of the hull, and which incline downwardly laterally towards the keel line of the boat, are made greater in front than in the rear. The forward hydroplane members merge into a keel having a centerboard effect.

International Marine Engineering

MARCH, 1910.

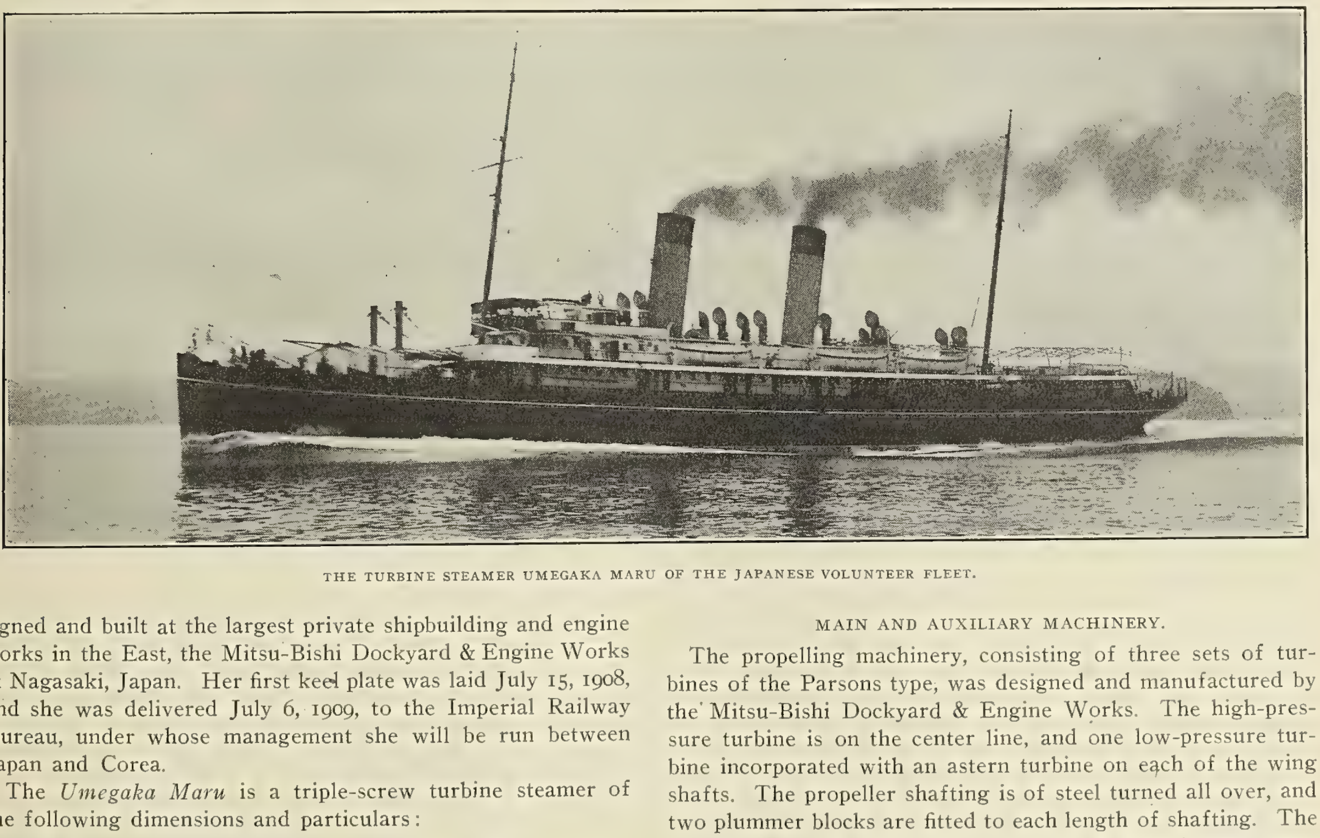
THE SECOND TURBINE STEAMER FOR THE JAPANESE VOLUNTEER FLEET.

The experience gained with the first Japanese volunteer steamer *Sakura Maru*, built over a year ago, has been of much value to the Imperial Marine Association, which is the organizer of the volunteer fleet, and in the building of the second steamer, *Umegaka Maru*, every effort has been made to make her most useful, both in peace and war, having none of hermaphrodite fancies, which existed to a certain extent in the first steamer, nevertheless having every provision for ready transformation into a useful implement of naval warfare. She is a handsomely fitted and well-appointed vessel, and was designed and built at the largest private shipbuilding and engine works in the East, the Mitsu-Bishi Dockyard & Engine Works at Nagasaki, Japan. Her first keel plate was laid July 15, 1908, and she was delivered July 6, 1909, to the Imperial Railway Bureau, under whose management she will be run between Japan and Corea.

The *Umegaka Maru* is a triple-screw turbine steamer of the following dimensions and particulars:

Length between perpendiculars	335 feet
Breadth molded	43 feet
Depth molded	30 feet 6 inches
Gross tonnage	3,200 tons
Draft	16 feet
Indicated horsepower	8,500
Speed	21 knots
Number of special first class passengers	2
Number of first class passengers	34
Number of second class passengers	81
Number of third class passengers	347

Mild steel was used in the construction, and great attention was given to the strength of the scantlings, which are greatly above the average for vessels of cross-channel type. The vessel also fulfils the requirements of Japanese shipbuilding and ship surveying regulations, and is subdivided below the main deck into thirty-six watertight compartments forming double bottoms, peak tanks, holds, oil bunkers, deep tanks, fresh-water tanks, engine and boiler rooms, steering-engine room, etc., which make the ship practically unsinkable, even if one or two compartments are flooded.



THE TURBINE STEAMER UMEGAKA MARU OF THE JAPANESE VOLUNTEER FLEET.

MAIN AND AUXILIARY MACHINERY.

The propelling machinery, consisting of three sets of turbines of the Parsons type, was designed and manufactured by the Mitsu-Bishi Dockyard & Engine Works. The high-pressure turbine is on the center line, and one low-pressure turbine incorporated with an astern turbine on each of the wing shafts. The propeller shafting is of steel turned all over, and two plummer blocks are fitted to each length of shafting. The propellers are of the solid type and are of Stone's manganese bronze, accurately polished all over, so as to reduce vibration and friction to a minimum.

The handles of all valves for the ahead and astern turbines are accessible from the starting platform at the forward end of the engine room, so that one engineer can have complete control of all the machinery. The condensers of Morrison's Contraflo type, of which the Mitsu-Bishi Dockyard & Engine Works is the licensee, are placed alongside the aft ends of the low-pressure turbines and are built of steel plates, with strong cast-iron end chambers, with ample cooling sur-

face, and so arranged that the circulating water passes twice through the condensers entering at the bottom. Each condenser is connected to one of the low-pressure turbines by a large steel eduction pipe. The cooling water is supplied to the condensers by two large centrifugal circulating pumps, each pump having a connection of about half the area of the delivery to circulate water through the condenser on the other side when one of the pumps is disabled.

The vacuum system includes Weir's wet-air pumps and Parsons augmentor condenser, and these, together with circulating pumps, are designed to insure the maintenance of the high vacuum necessary for the economical working of the turbines. There are two wet-air pumps of the twin type, and these are fitted at the forward end of the engine room, one on each side of the center line.

Pumps are also supplied for forced lubrication of the bearings, and for oil-cooling purposes. There is a full complement of pumps for the bilge, sanitary and fresh-water service of the ship.

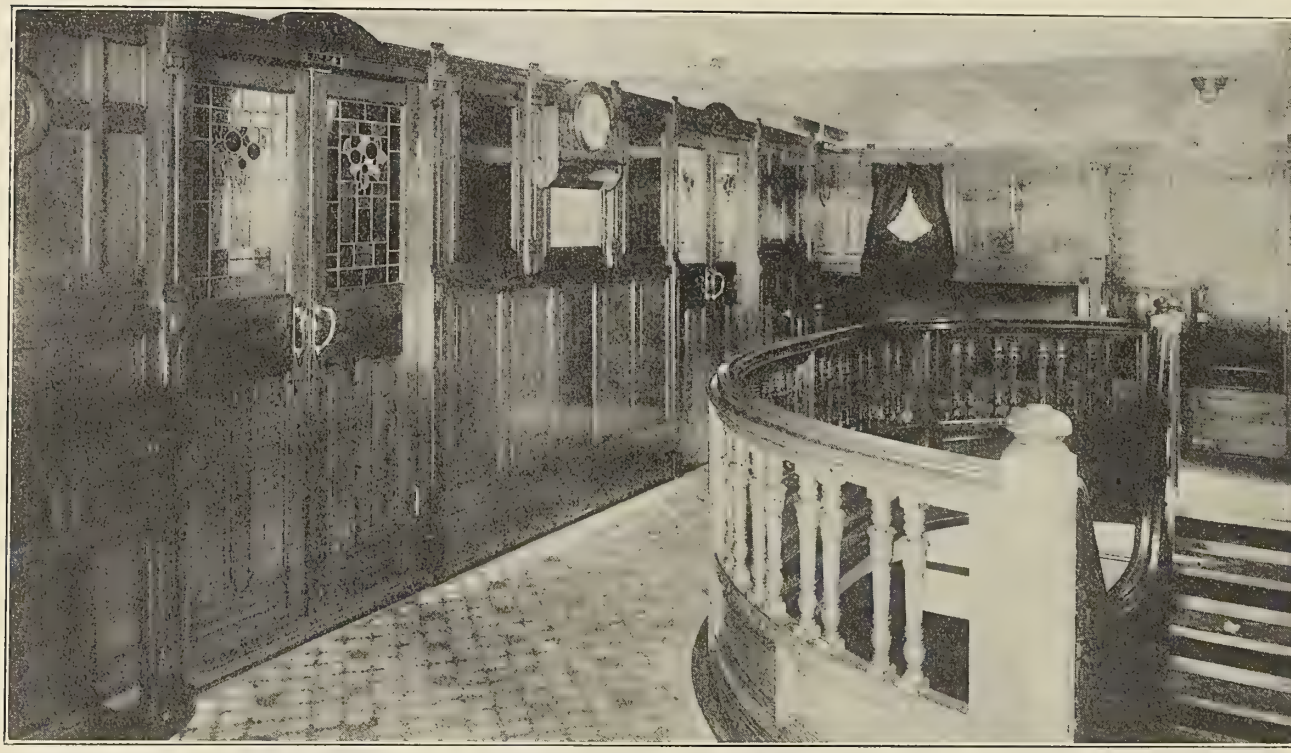
There are two pairs of Weir's double-acting feed pumps, each pair being capable of supplying the boilers when the turbines are exerting their full power. They are so connected that either pair may deal with the turbines. These pumps are arranged to draw from the hot wells through the float tank, condensers, feed tanks, boiler bottoms, fresh-water tanks and drain tank, and are fitted in the forward end of the engine room, together with a feed heater of the surface type and feed-water filters of the gravitation type. An auxiliary condenser with independent air and circulating pumps is also fitted at the forward end of the engine room.

The distilling plant consists of two evaporators capable of producing at least 30 tons of water per 24 hours, and two distillers capable of making about 10 tons of pure water per 24 hours.

A workshop is supplied with one lathe, one drilling machine, one shaping machine, one grindstone, etc. All these machines are driven by electric motor.

The engine and dynamos for the lighting of the ship and the supply of power to fans and machines are placed at the aft end of the engine room. Of these we shall deal later in connection with the passenger arrangement.

There are four double-ended boilers of the Miyabara patent watertube type, designed for a working pressure of 200 pounds per square inch. These are arranged in two boiler rooms, and there is also a donkey boiler of the cylindrical type for auxiliary purposes in the aft boiler room. There are two funnels, elliptical in section, 76 feet 6 inches high, above the level of the firebars. These are double, the space between the outer and inner funnels being utilized for the ventilation of the boiler rooms and stokeholes. The boilers are worked under forced draft on the closed stokehole system, the air being supplied by four fans, each driven by one double-acting steam engine. One air compressor is fitted for tube-cleaning purposes.



MAIN STAIRWAY OF THE UMEGAKA MARU, SHOWING STYLE OF INTERIOR DECORATION OF THE VESSEL

The Miyabara double-ended watertube boilers consist of three water legs, forming two combustion chambers between them, one on each side of the middle water leg. Each leg is composed of three horizontal cylindrical drums, arranged one above the other, connected together by short tubes, and a series of diagonal tubes connecting the three legs and crossing each other over the fire-grate. Within the three middle drums, and enclosing the ends of the two groups of generating tubes which meet therein, diaphragm junction boxes are fitted for the purpose of separating the upcast water rising through the generating tubes from the downcast water running down from the top steam drum to the bottom water drum, thereby preventing interference between the upcast and downcast circulating water. A steam dome is fitted over the three water legs and connected to their tops. The tubes are of mild steel, solid drawn and cold finished, and were tested to a hydraulic pressure of 1,000 pounds per square inch before being worked into place. The drums are made of mild steel. Each boiler is fitted with three furnace mouths at each end, and the furnace doors open inwardly, resting on horizontal spindles and fitted with balance weights. The ash-pit doors are so arranged that in the event of a tube bursting under steam,

they would close automatically. The whole is enclosed in sheet metal casing.

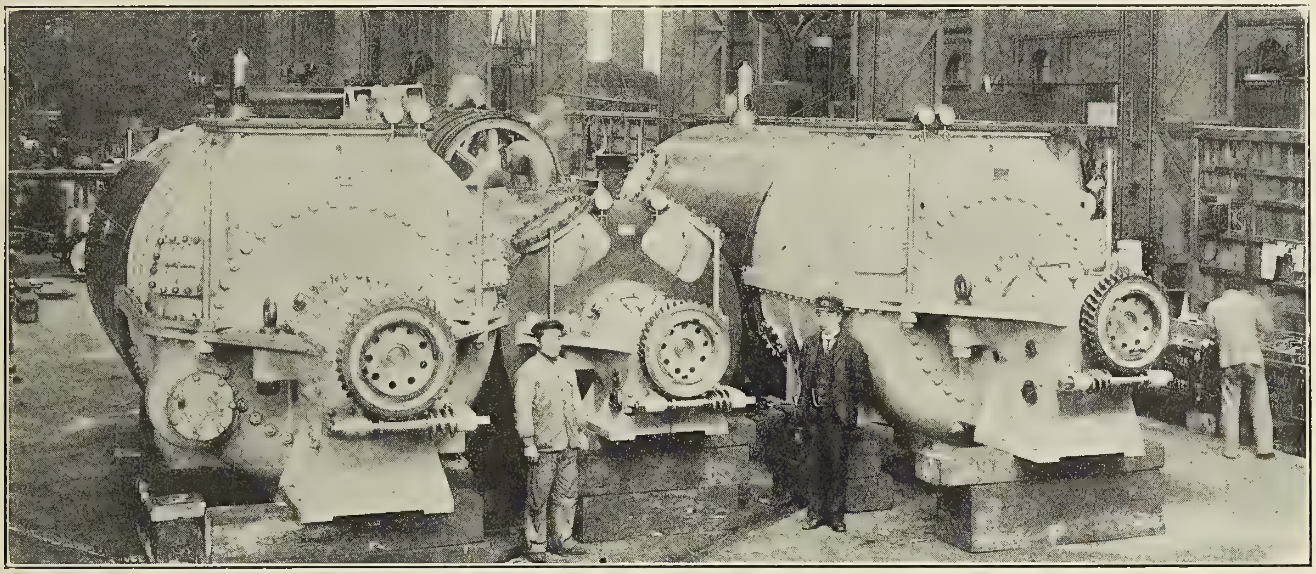
The boilers are fitted with a complete installation for burning coal and oil in combination. Körting burners are provided in conjunction with the Flannery-Boyde system of settling tanks. The oil is injected into the furnaces by means of mechanical pressure, being delivered by pumps to the burners. There is a full complement of oil strainers, oil heaters, oil feed pumps, pressure oil pumps, etc. A steam ash-hoisting engine and a See's ash ejector are also fitted in each boiler room.

Progressive endurance and full-speed trials were carried out with the vessel, her performance being exceptionally satisfactory throughout. On the full-speed trial she attained a speed of 21.3 knots as the mean of means of six runs on the measured 3-mile course, outside of Nagasaki harbor, the maximum speed being 21.575 knots. The speeds obtained in the six consecutive runs were as follows: 21.135, 21.465, 21.100, 21.538, 21.135 and 21.575 knots.

health officers, and the aft house containing the second class dining saloon and hospital.

The main entrance to the first class accommodation is on this deck; the general design and paneling is of polished wainscot oak, and the floor is laid with interlocking rubber tiling. In the center is an easy stairway leading down to the spar deck, and two side stairways leading up to the promenade space on the boat deck. It is lighted and ventilated overhead with a large skylight decorated with stained glass.

Forward of the main entrance are the reading room and saloon. The decoration of the reading room is worked out in wainscot oak panels and framing, and the ceiling is finished in panels, painted in unglazed white and gilded. The furniture is also of polished oak, and sofas and seats are richly upholstered in heavy silk of dark green shade. The windows and doors are hung with rich silk curtains of the same shade as the sofas, and the floor is laid with Wilton carpet and runners. There is fitted an upright cottage piano from the Nippon Musical Instrument Factory; decorated and



PARSONS TURBINES FOR THE UMEGAKA MARU, BUILT AT THE MITSU-BISHI DOCKYARD AND ENGINE WORKS.

GENERAL ARRANGEMENT.

The vessel is schooner rigged, with two pole masts fitted with the necessary derricks for the rapid handling of cargo; while her two large, oval funnels give her the appearance of a mammoth ocean liner in miniature.

There are five decks; the boat, shelter, spar, main and lower decks. At the forward end of the boat deck, which extends for about 240 feet amidships, there is a large deck house to accommodate the special passengers, and the navigating officers with a navigating bridge and chart room directly above. Six lifeboats are stowed on this deck, while the remaining area forms a promenade for first class passengers. Two boats, one gig and one tenma (native boat) are stowed on the aft boat deck, which forms a promenade for the second class passengers. All the davits are of Welin's patent quadrant type, the two pairs for lifeboats amidships being of extra strength, in order that one pair may be used for a steam pinnace weighing 7½ tons, and the other for a pinnace weighing 3½ tons.

The shelter deck forms the principal deck of the vessel. Large houses are constructed on this deck, the forward house containing first class staterooms and public rooms, the midship house containing cabins for the senior engineers, custom and

finished in oak in a manner to harmonize with the remainder of the room. Adjoining the reading room is the dining saloon. Seating accommodation is provided for thirty-four passengers arranged at small tables. The decoration is also in oak. The ceiling is paneled and painted in unglazed white and gilded. It is lighted by two skylights with stained glass; thus giving the room ample light and air overhead. The saloon is also lighted and ventilated by a number of large rectangular side lights, with silk hangings of dark crimson color. Sofa seats upholstered in silk of the same shade are placed round the sides of the saloon. There are two sideboards of polished oak at the ends of the saloon. The floor, which is of wood parquetry, is laid with Wilton runners and mats. Service is from a roomy pantry in close proximity.

In general the design of carving and stained glass in the reading room and saloon is based on the plum blossom, and is purely Japanese in style.

Aft of the main entrance and about the boiler casing there are first class staterooms, lavatories, smoking room and bar.

The smoking room is located between the boiler casings and extends the full breadth of the deck house. Here the paneling and framing are of fumed oak, and the furniture is also of fumed oak. A prominent feature of this room is a

large panel on the forward bulkhead painted by Mr. Giokusho Kawabata, member of Artisans for the Imperial Household. Small tables and chairs are comfortably arranged about the room. The upholstery is of dark brown morocco, and the hangings are of silk of similar shade. Overhead there is a large central skylight decorated with stained glass of Oriental Zodiacal design. The floor is of interlocking rubber tiles.

The forward portion of the spar deck is arranged for the third class passengers. Aft of this there is additional accommodation for first class passengers; midships the officers are quartered, while the aft part is entirely utilized for the second class passengers. The firemen are also berthed in this deck.

The second class dining saloon on the shade deck accommodates twenty-eight passengers. Its paneling and framing are painted white, with polished teak dado. The ceiling is also paneled and painted white. It is lighted and ventilated by a large overhead skylight. The furniture is of polished teak. A small pantry is fitted at the aft end. Aft the dining saloon there is an easy stairway leading down to the sleeping accommodations on the spar deck.

The third class passengers are berthed partly on the spar deck and partly on the main deck. The greater portion of the third class space on the spar deck is occupied by the lavatories, etc. The berths are of wood on galvanized iron framing, common to those steamers trading in Eastern waters.

Purser's, doctor's, engineers', chief steward's, cooks' and stewards' rooms are arranged midships. Near the purser's room and below the main stairway there is a specie room in which valuables can be carried. It is substantially built of steel, with a strong door fitted with Chubb's patent locks. Adjoining the doctor's room is a dispensary and then an officers' mess room; those three rooms are accessible to each other, thus providing the means of turning the mess room into a sick bay when required, and for this purpose the deck is specially insulated and cemented.

A telephone room is annexed to the clerk's office at the end of the officers' quarters, which is so arranged that while the vessel is lying at a wharf it may be connected with the city telephone for general communication.

Forward of the second class space is a large mail office and postmaster's cabin. The mail room is completely fitted out to meet the requirements of the Imperial Post for sorting mails en route. The furniture is of polished teak. The main deck, forward, is arranged for third class passengers, while at the extreme end are the crew's quarters. Mail rooms, mail clerks and apprentices are located at the aft end, while the midship portion of this deck is entirely taken up by the machinery.

The forward lower deck is arranged for various stores and the after one for cargo space.

There are many notable features in connection with the sanitary arrangements, for baths are fitted for all classes of passengers, and for the officers and crew. Those for the first class passengers and officers are fitted with showers and heaters, and those for third class passengers and firemen with heaters. A considerable number of hot-water boilers and hot-water heaters with steam and water connections are distributed over different parts of the ship. Expensive as all these arrangements are, they insure perfect sanitation for the vessel. All sanitary apparatus is supplied by Messrs. Shanks & Co.

A complete refrigerating plant by Messrs. Hall & Co. is fitted for the preservation of fresh provisions. The cold chamber is subdivided into four compartments, having a total capacity of over 1,200 cubic feet. It is also arranged to make 336 pounds of ice daily without interfering with the cooling of the chamber.

For electric light and power there are two sets of engines and dynamos together, capable of developing 60 kilowatts, each set being capable of generating and supplying light equal to 6,424 candlepower, and of supplying the necessary current for three cluster cargo lamps of 200 candlepower each, for all signal lamps, for the workshop machines, and for forty-six electric fans. The engines are of the self-lubricating condensing type, running at about 350 revolutions per minute. The dynamos are of 100 volts and six-pole compound wound. Both sets are placed at the aft end of the machinery space on the main deck. The current is transmitted by insulated cable of high conductivity; all wiring being done on the double-wire distributing box system. A marble switchboard is fitted in the dynamo room, from which the mains are led to their respective junction, switch or distributing boards throughout the ship. The masthead, side and stern lights are fitted with 32-candlepower lamps, with an indicator placed in the chart house to show when they are burning. The engines and dynamos are of the builder's own make.

Electric bell communication is provided to all staterooms and senior officers' rooms. A telephone of Graham's marine type is fitted between the navigating bridge and engine room.

For ventilation each compartment has outlet and inlet ventilators. Twenty-one large overhead electric fans are distributed through the public rooms, and over twenty-five bracket fans to the staterooms and senior officers' rooms and a large exhaust fan to the dynamo room.

The steering gear of Messrs. Caldwell & Co., with telemotor and shaft gear, is placed in the lower deck, with an emergency steam gear on the main deck. The gear is actuated from the navigating bridge, also from the steering station at the aft end of the boat deck. A capstan of the same make is fitted on the shelter deck and worked by means of shafting and gear from the emergency steam gear.

The steam windlass is by Messrs. Napier Bros., and the cargo winches are of the builder's own make. Engine room, steering, docking, lookout and anchor telegraphs are of Messrs. J. W. Ray & Co.'s make, while the electric direction tell-tales are supplied by the Tokyo Measuring Instrument Factory. An innovation of Walker's patent Neptune electric ship log is seen in the ship.

ENGINEERING EDUCATION IN THE NAVY.*

The education of naval officers in engineering to provide for the demands of the service starts at the Naval Academy. There, as a foundation, all line officers are given what is probably the best technical education furnished by any school in this country. This tribute to the Naval Academy is based upon the method of selection of the student and upon the method of elimination of the student at the school, quite as much as upon the excellent system of technical education that has been developed within the last half century and that has been particularly improved within the last ten years. The Naval Academy is still being improved, and it is to be hoped that progress will not cease, but to-day it is considered by the bureau and, what is more to the point, by many skilled educators, to be the finest school of engineering in the country.

The graduates of such a school are naturally fit to undertake subordinate engineering duties of all sorts, and that is what they get, one and all. For five years, or until they have been promoted above the grade of ensign, they perform duties, under the naval regulations, alternately on deck and in the engine room. Whatever their duty is named, it is engineering duty in fact. Almost every act of the line officer has to do with machinery and with engineering. This may be direct, as

* From the annual report of H. I. Cone, engineer-in-chief, United States Navy.

when his duties involve maintenance of the machinery plant, or it may be indirect, as when his duties involve the executive duties of handling a ship, or of directing men that are directly engaged in handling the mechanical appliances of such widely varied sorts as are found on our vessels. The line officer lives, as may be said, in a heavily charged engineering atmosphere, and in actually performing his duties in gunnery and in electricity, he is constantly directing the operation of complicated machinery, and is conversant with the average mechanical problem. By training and by the constant exercise of authority he is an excellent administrator, and by profession he is a directing influence to those under him. Through his general experience, the line officer possesses one qualification which no other officer in another corps or branch of the service could possibly attain, namely, the knowledge of and appreciation of the aims of his superiors from a military standpoint. In other words, he is vitally interested that his ship shall be in condition to meet any call from his captain or his admiral, with a knowledge of the nature of the requirements born from constant speculation as to what he will do when he becomes captain or admiral.

This continuous performance of engineering duty, using the term in an engineering sense rather than in the service one, fits the line officer for the superior duties of senior engineer of our vessels. The bureau wishes definitely to state that the problem confronting it does not include the keeping of the motive machinery of the fleet in condition, for that has been solved, and there are to-day a sufficient number of line officers fully competent to fill the position of senior engineer officer. This fact is evident from the present superior mechanical efficiency of our vessels in commission; from the decreased proportionate amount of the repairs necessary for the maintenance of the ships' machinery in good condition; from the increased proportion of repairs incident to the service that are being performed by the ships' force; and this with increased strains on the machinery, due to their now being more frequently operated at or near their designed power than has formerly been the case. The credit for this performance belongs in various quarters. Great credit is due the enlisted personnel, and in particular to those of them that have evidenced such energy and ability as to secure appointment as warrant officers. Obviously, however, the main credit is due to those responsible officers who have had charge of the machinery, and to their immediate official subordinates. These have proved their worth, and they have justified the legislation of 1899 that made all engineers line officers and that made all line officers engineers. It is now generally recognized throughout the service that the latter truth was as much a result of the personnel law as the former one. All officers lean upon the expert engineer's knowledge in developing improvements in any branch of naval efficiency. It will be found to-day that former engineer officers are occupying positions of high responsibility under every line bureau of the department, and that many officers who never received any special engineering education are performing with eminent success duties under this bureau.

There is one branch of engineering that this excellent general education does not fully qualify all naval officers to perform: The important work of designing the machinery of our vessels. When the personnel law was passed, the Congress provided for the needs of the service so far as expert designing engineers are concerned, by reserving a certain number of the old engineer corps exclusively for engineering duty. It was foreseen at that time that this was a temporary expedient, sufficient for the needs of the immediate future, but not sufficient to provide for the then comparatively remote time when the officers of the old engineer corps reserved for engineering duty only should pass from the active list of the officers of the navy. No direct provision to cover future needs of the service was made in the personnel law of 1899, but ample authority was left with the Secretary of the Navy to solve this question through his power to detail officers to such duty as he deems most desirable.

Successful, efficient, safe operation of machinery can only result from competent and careful design. The successful cruise of the Atlantic Fleet around the world is as much a tribute to the excellent work of the older engineers who designed the machinery of that fleet as to the efficiency of those that handled the machinery. It is essential to future success that we have competent, expert designing engineers to do the work that the older engineers so efficiently performed in the past. Now, by definition, the expert is a man who is generally well qualified in all branches of his profession, but who devotes his entire attention and directs his whole effort along some one line of that profession. That the designer of a marine engine must be an expert in order that his design may be entirely successful cannot be doubted. Therefore, we must have at all times a limited number of officers in the navy who devote themselves exclusively to scientific engineering. This accords with the expressed opinion of the personnel board of 1899, that some specialization for the design and inspection of machinery should be created.

Since the passage of the personnel law of 1899, every engineer-in-chief has seriously advocated some method of securing special training for a small number of officers to provide for the time, now comparatively near at hand, when the designing and other scientific engineering work must be done by others than officers of the old engineer corps. All have advocated some school of engineering. It has been the good fortune of the present chief of this bureau to reap the benefit of the plans of his distinguished predecessors, and to propose to the department a plan for the creation of such a school of marine engineering that has been adopted and that will, it is believed, provide for the needs of the service in the future.

The principal object of the recommendation favoring such a plan was to secure an adequate, but small, number of thoroughly well qualified engineering experts to perform designing engineering work for the navy. To reap the full benefits of the personnel bill and to secure the very best future designs, it is, in the bureau's opinion, an essential qualification that these officers should be all-round naval officers of ample general experience, to enable them properly to adapt naval machinery to the requirements of the service. This implies several years' experience at sea, and it also implies the performance by all of these officers, at some time previous to their selection as designing engineers, of that sort of duty commonly called line duty, namely, executive duty, concerned with the ship as a whole as a unit in the fleet. Some such duty is essential to that clear and broad conception of the requirements of the service that it is essential should govern all designs of naval vessels and of naval machinery.

Ten officers have been selected from applicants for this duty for detail to the School of Marine Engineering. These officers have had at least three years' sea service, and have been selected according to their evidenced capacity. Provision is made for the selection of officers for designing duty from among those specially well qualified by education, experience and inclination, pending the time when graduates of the school will be eligible for such detail under the terms of the order.

The headquarters of the School of Marine Engineering is fixed at Annapolis, in accordance with the bureau's recommendation. This recommendation was made after careful investigation and consideration of the advantages of various private institutions of learning.

The annual meeting of the Institution of Naval Architects will be held March 16, 17 and 18 in the Hall of the Society of Arts, John street, Adelphi, London, W. C. The Right Hon. Earl Cawdor, president, will preside.

ORE-HANDLING EQUIPMENTS FOR LAKE VESSELS.*

BY RICHARD B. SHERIDAN.

MODERN UNLOADING MACHINERY.

With the introduction of the grab bucket there have been practically but two types of machines developed: One, that employing a bucket suspended by the operating ropes, and the other a grab bucket carried on a rigid arm. The first type is shown in Fig. 5, and the other type in Fig. 6.

The machines shown in Fig. 5 are unloading plants built for the Pittsburg & Lake Erie Dock Company, at Fairport, Ohio, and the equipment consists of six units. Generally each of these units consists of a structural steel pier mounted on double-track equalizing trucks, and each truck carried on four double flanged, chilled tread wheels. Each pair is designed to carry a traveling hopper or chute, designed to deflect the ore into the railway cars running beneath the same. An apron extension it attached to the main runway on which the trolley operates, and designed to project over the vessel. This extension is made so that the same may be raised and lowered to facilitate boats coming into dock. At the rear end generally a cantilever projection is arranged so that the ore may be dumped into a stock pile at the rear, for the purpose of rehandling into cars or into a more permanent stock pile as the case may be. The machines are designed to be moved along their supporting rails by power, the moving-gear mechanism being located in a small house above the trolley track or runway. From this mechanism, shafting and gearing transmits the motive power to each of the supporting truck wheels, thereby allowing the machine to be moved along its supporting rails at the will of the operator.

The man trolley on each machine consists essentially of a steel frame, mounted on track wheels and arranged to run on the structural steel runway of the pier. The trolleys are made self-propelling, the method of moving being by wire ropes attached to each end of the runway and passing over a drum located on the trolley frame. By this method the trolley can be accelerated very quickly and stopped quickly, which would not be the case with trolleys operated by the tractive force of the supporting wheels. To the trolley is attached the operator's cage, from which point the operator controls all of the motions of the machine. The hoisting mechanism operating an 80 cubic feet grab is carried on a turntable, located within the trolley frame, and by this arrangement the bucket may be turned through an angle of about 180 degrees. This feature allows the bucket to be turned so as to open fore and aft of the vessel and thus reach in under the deck between the hatches. The length of the bucket open is such that in boats whose hatches are 12 feet centers, the bucket when working in adjacent hatches will reach in past the center of the ore lying under the deck between the hatches, the whole purpose of this arrangement being to reduce, as far as possible, hand labor within the boat.

The electrical equipment in one of these machines consists of two 125-horsepower motors for hoisting the bucket, one 100-horsepower motor for racking the trolley, and one 3½-horsepower motor for rotating the bucket. The machine is propelled along its supporting rails by a 75-horsepower motor.

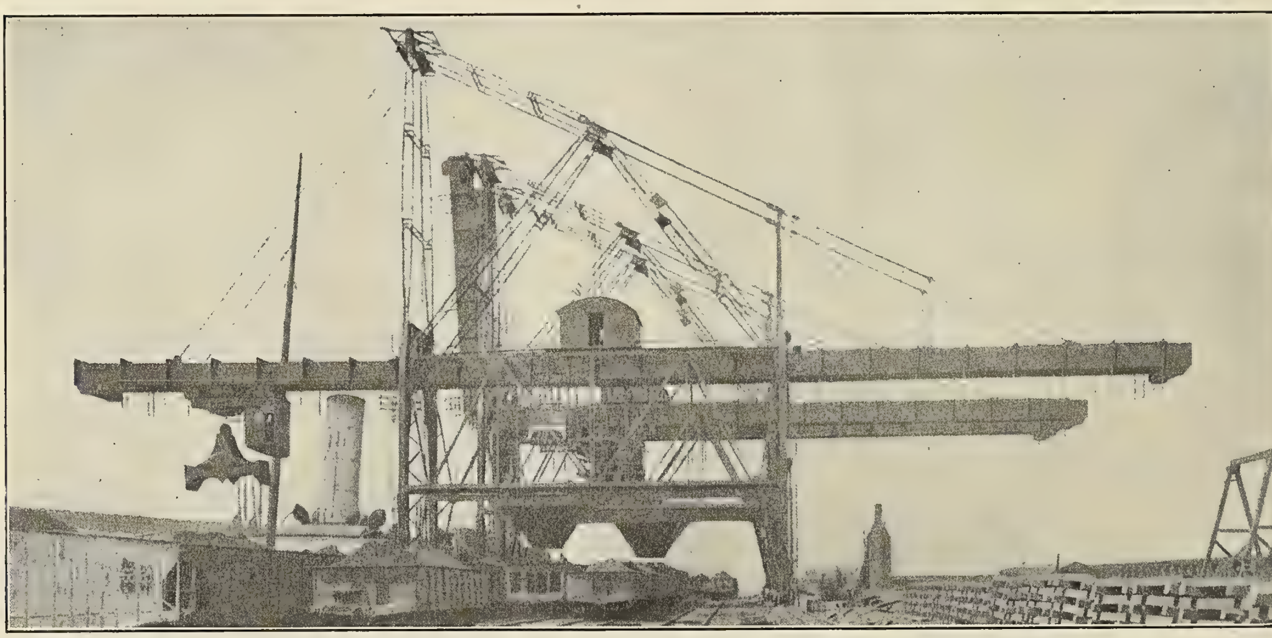


FIG. 5.—FOUR ELECTRIC HOIST PLANTS, PITTSBURG & CONNEAUT DOCK COMPANY, CONNEAUT, OHIO.

With the above electrical equipment the speeds of the various functions range about as follows:

Hoisting, 300 feet per minute; trolley, travel, 800 to 900 feet per minute; machine travel along the supporting rails, 75 to 100 feet per minute.

The main dimensions of the machines now used of this type are approximately as follows:

Span of pier, 62 feet 10 inches; cantilever projection over the water, 59 feet 3 inches from center of shear leg next to waterfront; cantilever projection at the rear, 100 feet from center of rear shear leg; height of runway above supporting tracks, about 44 feet; total hoist of bucket, about 74 feet.

The moving-gear mechanism is arranged with a solenoid brake, designed so that when no current is passing through the motor the moving-gear mechanism of the machine is locked. The hoisting and lowering of the bucket from the trolley is controlled by a powerful foot-band friction brake, and the racking motion of the trolley is controlled by an independent band friction brake.

There have been many different proportions of machines of this character, but the type shown in Fig. 5 is the one generally used.

* Concluded from the February issue.

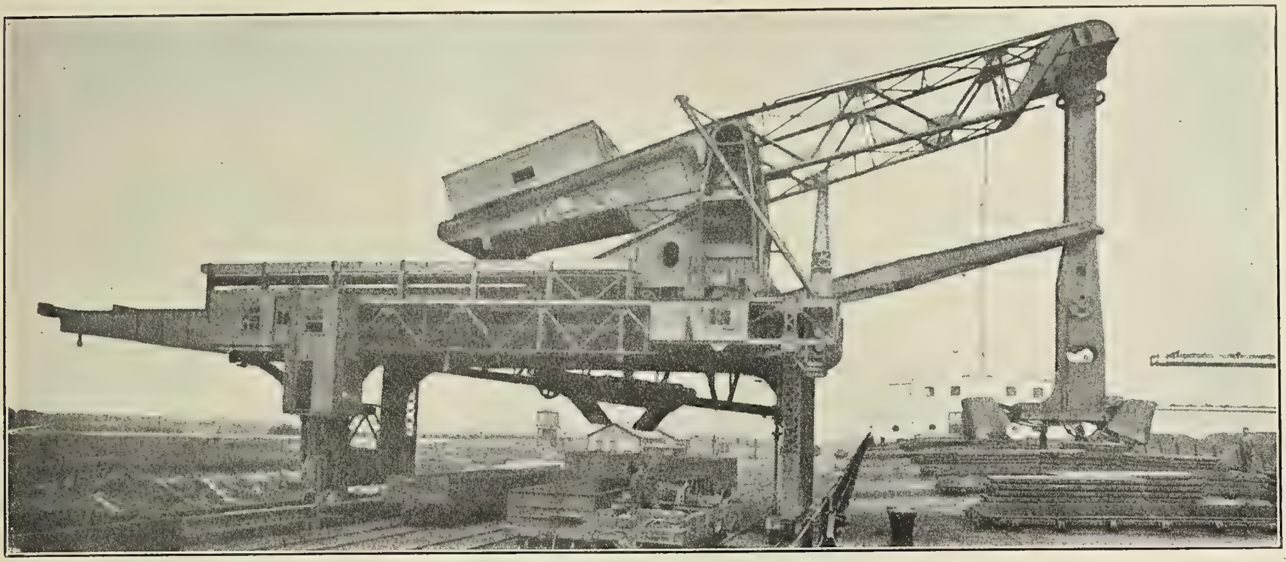


FIG. 6.—GRAB-BUCKET CARRIED ON A RIGID ARM.

A similar type of machine arranged with no cantilever at the rear, but equipped with a 200-ton weighing hopper or bin, in the pier itself to take the place of the small deflecting chutes and designed to weigh the ore or material directly into railways cars running beneath is sometimes used. Machines of this type are particularly advantageous on docks where ore is handled directly into cars for shipment. In general the machine is the same as that of the other type.

The weighing bin is an interesting feature. It is rectangular in plan, being 27 feet 4 inches long by 18 feet 6 inches deep. Its sides and ends are curved to a parabolic form, so that the bin is like a huge bag. It is carried from the pier structure through a set of specially designed scales, the method of suspension of the bin being from the four corners by rods. In the bottom of the bin are two chutes, each being 2 feet wide by 7 feet long. These chutes are arranged in the bin so that both will dump into the same railway car lying beneath. The chutes are each arranged with an electrically operated gate, the two gates being so arranged that they will work simultaneously when opening and closing. The closing edge of the gate is cut away in a V-shape in the middle and tapering off towards the ends. By this arrangement the stream of ore passing through the chutes may be gradually cut down to nothing, the purpose of the indentation in the closing lip of the gate being to reduce the stream more gradually than it could be if the whole 7 feet had to be figured on. The bin weighing mechanism is fitted with plus and minus weighing beams, so that the ore going into the bin is continually noted, and likewise the ore drawn off is easily weighed and kept track of. The whole design of this bin, its method of suspension and the scale feature is one which would constitute a paper in itself, and therefore I am obliged to pass over it with this very meager description.

Machines of this type, with 5-ton buckets, have no difficulty in handling ore, from the modern lake vessel with hatches spaced 12 feet centers, at the rate of 400 to 425 tons per hour when breaking into a hatch, and there are many records where boats of modern dimensions have been unloaded by a plant of these machines at the average rate of 319 tons per hour per machine, and at a power consumption varying from .35 kilowatt hour per ton of ore handled to .5 kilowatt hour per ton of ore handled, this variation de-

FIG. 7.—FIVE BRIDGE TRAMWAYS FOR UNLOADING ORE FROM A BOAT DIRECT TO THE STOCK PILE AT A FURNACE PLANT.

pending upon the class of boat unloaded and the efficiency of the operators.

The unloading machines above described have met all of the various conditions to be overcome in handling ore from boat to railway car. The question of handling ore from boat to stock pile has been taken care of in two ways.

Where the stock pile is at a furnace plant and is drawn from for that purpose, a type of machine similar on general principles to the first unloading machines has been developed. This type of machine is shown in Fig. 7. Each of these machines consists of a bridge span with an apron projection over the water and supported on one end by a pier and on the other by a shear leg. The entire structure is mounted on wheels and arranged to be moved along the supporting rails at the will of the operator. In place of having the operator at some fixed point, as in the early types, he is arranged to travel with the trolley in the same manner as on the fast plants described above. In general, machines of this type are but lengthened-out fast plants and serve the same purpose, but on account of the longer run of the trolley, the capacity per hour from boat to stock pile is somewhat reduced.

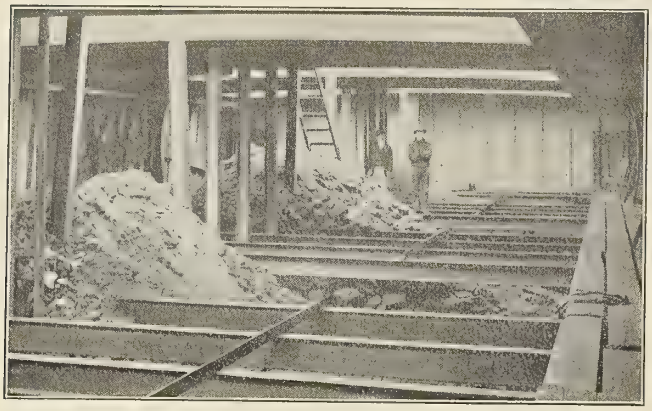


FIG. 8.—HOLD OF OLD-TYPE ORE VESSEL, HATCHES SPACED 24 FEET CENTERS.

Another very popular and economical method of handling material into stock has been used by many of the dock companies. The arrangement consists of a battery of fast plant unloaders at the water front and cantilever projections at their rear. And then in connection with these machines a separate stocking bridge of larger capacity is arranged to take the material from the pile made under the cantilever projection at the rear of the fast plant.

The other type of unloading machine is commonly known as the "stiff leg" and is shown in Fig. 6. It was invented by Mr. G. H. Hulett, of the Wellman-Seaver-Morgan Engineering Company. These machines have been built with buckets having a capacity of 10 and 15 tons. They were originally designed to be controlled by hydraulic power, but since the first machines they are now being built for electric control throughout. It may be stated that they form a distinct class of their own, and while there are several different designs made to suit special conditions, the following applies to all of the stiff-leg unloaders.

The machines consist in general of a bucket mounted on the lower end of a vertical rotating bucket leg, which is supported by a walking beam and always kept in a vertical position by a parallel arm to the walking beam. The walking beam is carried from trunnions supported by a mast on the front end of a trolley frame, which travels back and forth on a pair of girders forming the span of a gantry frame. The gantry frame is set at right angles to the face of the dock and arranged to travel along the same on tracks running parallel to the dock front. On the gantry frame, over the railway tracks, is arranged a movable transfer car, designed to receive the material from the bucket, and this transfer car dumps the contents into cars directly beneath on any one of the several tracks running along the front of the dock. The various functions of opening, closing and rotating the bucket and racking the trolley are accomplished by an operator situated in the bucket leg directly over the bucket.

The bucket itself is made up of two separate scoops, the same as is generally found in the ordinary grab bucket. These scoops or plates are carried on wheels, which are arranged to run in predetermined paths on the end of the fixed bucket arm and are further operated by bucket arms, which are connected in the present machines to electric motors placed on the rear of the walking beam. The arrangement is such that the operator located in the end of the bucket leg can control the opening and closing of these bucket blades. One of the blades in this type of machine has only a rotating motion, while the other one has a rotating and scraping motion. By this method the entire opening or reach of the bucket is obtained by one blade, which throws the system off the center of the rigid bucket arm, the purpose of this eccentricity being to accomplish a long reach under the deck between hatches. This feature, along with the rotating feature of the bucket arm, gives the machine an easy control in securing the load for the bucket. After securing a load, the entire bucket and arm is raised vertically with the parallel motion above described, until the bucket is brought to a height sufficient to dump into the transfer system. The trolley carrying the walking beam is then traveled on the gantry structure carrying the same until the bucket has been brought over the transfer car where the load is dumped. The various functions of opening, closing and rotating of the bucket, together with the racking of the trolley carrying the walking beam, are accomplished by the operator in the bucket leg. Another operator controls the motions of the transfer car into which the bucket deposits its load. The walking beam carried on the bucket arm and bucket is, as can be seen, balanced by means of the machinery and a cast iron counter-weight at the rear end, so as to allow only a sufficient amount of unbalanced load to warrant the bucket taking its rated capacity. The trolley, which supports the walking beam, is carried at the front end by a pair of four-wheel equalizing trucks, and at the rear end by a pair of two-wheel trucks. The racking movement of the trolley is accomplished through a pair of spur pinions meshing with a pair of

FIG. 9.—HOLD OF THE WOLVIN, SHOWING FIRST RADICAL CHANGE IN CONSTRUCTION.

racks attached to the gantry structure. The pinions are driven through spur gearing from the moving-gear motor. On account of the center of gravity of the walking beam and bucket arm being in front of the trunnions supporting the same, the rear end of the trolley supporting this walking beam is provided with a pair of inverted trucks to insure equilibrium. Further, the travel of the trolley supporting this walking beam is provided with automatic stops to prevent over-travel. The hoisting motion of the bucket leg is limited in its upward travel by automatic electric cut-outs and a mechanical safety latch at the rear end of the walking beam, which is designed to hold the beam in case of extreme travel. All of the operating machinery is provided with solenoid brakes, which are set when the current is off.

The transfer car running beneath the trolley carrying the walking beam is racked back and forth by means of cables,

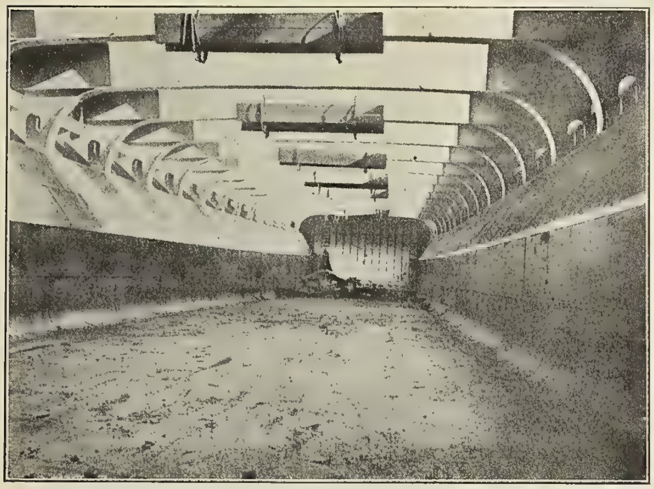


FIG. 10.—INTERIOR HOLD OF LATEST TYPE OF ORE CARRIER.

the mechanism for operating the same being located in a house in the rear of the machine and controlled by a separate operator, also situated in this house.

The electrical equipment on the latest machines of this type, which are located at Ashtabula, Ohio, and are rated as 15-ton machines, is as follows:

One 200-horsepower motor for raising and lowering of the bucket arm; one 100-horsepower motor for closing the bucket; one 25-horsepower motor for rotating the bucket arm; one 75-horsepower motor for traveling the walking beam trolley; one 25-horsepower motor for operating the larry gates; one 100-horsepower motor for moving the total machine along its supporting rails, and one 150-horsepower motor for operating the transfer larries.

This type of machine is much heavier than those of the suspended bucket type, and requires particularly heavy foundations, and as may be seen, more men to operate than the suspended machines described before. They further are not so designed that they may take out of stock, which, in some cases, is a disadvantage.

INFLUENCE OF GRAB ON SHIP CONSTRUCTION.

Fig. 8 is a view of the interior of one of the older types of ore-carrying boats, with hatches 24 feet centers. After the adoption of the grab bucket the various beams, stanchions, etc., were a great hindrance and caused delay in the rapid discharge of the material. The result has been that the hatches have been spaced about 12 feet centers.

Fig. 9 gives the interior view of one of the first radical changes in ship construction worked out. This picture is of the interior of the steamer *Wolvin*, which has a carrying capacity of about 12,500 tons. Her length is 560 feet over all, 540 feet on the keel, with a beam molded of 56 feet at the widest part and a molded depth of 32 feet amidships. At the time she was built she was considered novel, inasmuch as the cargo hold was of different form than that of any other boat built up to that time.

This was constructed in the form of a hopper with sides that sloped from the main deck down to the tank top, and the ends built on the same slope. This hopper extends in one continuous length 409 feet without bulkheads or divisions of any kind, and its width measures at the top 43 feet, and the bottom 24 feet. This construction was adopted so as to accommodate the use of the automatic clam-shells in unloading the cargoes, and while it serves the purpose it also serves to make a very strong and rigid vessel. Another feature in the construction of this boat is the fact of the ordinary stanchions being dispensed with, and in their place a system of girder arches are substituted to support the upper deck, as well as the sides of the boat. In her deck plan there are thirty-three cargo hatches on the spar deck, each one measuring 33 feet by 9 feet in the clear and spaced 12 feet center to center, so that it is possible for the clam-shells to unload the vessel practically without any hand labor.

Fig. 10 shows the latest departure made in the ore-boat construction. In the case of the *Wolvin* the sides of the hold sloped in at an angle, with the idea that the material would run down and be in a better position to be handled by the grab buckets. As is apparent, the sides projected out so as to allow the bucket, when lowering, to drop onto the sides, and much damage can be done to the boats, and there is no real advantage in gathering up the material. In the type of construction shown in Fig. 10, the sides are brought in on a slight slope, and then vertically down to the tank top, the vertical side being inside of the hatch combing, so that a bucket in dropping through the hatch would not come into contact with them, and, furthermore, having the vertical sides, the buckets were able to work close up to them and obtain, with less damage to boat, a bucket of ore, than in the type of boat such as the *Wolvin*. The *Wolvin* type, however, has not been generally repeated, and most of the modern boats have an interior construction very similar to that shown in Fig. 10.

EVAPORATING PLANTS ON BOARD SHIP.

BY WILLIAM J. AUKEN.

Fresh water made by the evaporation of salt water at the expense of coal burned can never be as economical as obtaining the product from shore; hence we find tanks fitted aboard ships, usually of sufficient capacity to furnish all the water needed in runs between ports, where a fresh supply becomes available. There are many exceptions to this rule, however, which may make an evaporating plant desirable, or even a necessity. Naval vessels, with their large crews, making long voyages, together with numbers of ocean yachts, may be considered as in the latter class, while many other ships at some time during their trips, find it extremely profitable to replenish a vanishing water supply outside their port limits.

The usual adjunct for increasing the supply of fresh water beyond the tank capacity is the evaporator. This useful appliance consists of a cylindrical shell containing a cast head on one end, if of the horizontal type, or on the lower side when vertical; to which is attached banks of tubes, and through which steam is passed in order, from the top to the bottom; draining from the last coil into a trap, and thence to the feed tank or hot well. Sea water is fed into the shell surrounding the heated tubes, and being vaporized passes out at the top into the vapor pipe. On many ships this pipe is connected to the auxiliary or main exhaust, the vapor finding its way into the condenser, where it is condensed with the ex-

haust steam and adds to the volume of the feed water. There being a partial vacuum in the exhaust piping, the boiling point of the water in the evaporator is lowered, consequently a greater quantity of water can be evaporated for a given amount of steam than when evaporating under greater pressure.

One or two minor refinements are possible with this method. The low pressure in the evaporator makes a salt feed obtainable without a special pump. Where arrangements permit, this should be taken from the overboard discharge of the main circulating pump, as this sea water has been warmed in condensing the exhaust steam. Locations not permitting, the flushing-line discharge offers another possible suction, though here the water enters at a lower temperature (that of the sea). When a separate evaporator feed pump is advisable, the former suction should be chosen.

This evaporating plant, simple in the extreme, will make large quantities of feed water with little or no attention; takes up but small space, and needs few connections. The objection, which leads to more complicated arrangements, is the quality of water produced. Where the vapor passes directly into an exhaust pipe its quality cannot be tested, hence when poor water is made it must contaminate all of the previous yield. The boiling point of the water being low, because of the partial vacuum under which it is evaporated, the steam bubbles formed are large, the vapor heavier than when higher pressures are used, and the amount of water held in suspension is also greater, hence the tendency to prime is always present. This is aggravated by the usual method of connections.

To insure against this evil, the vapor pipe should rise vertically from the evaporator 10 or 12 feet before connecting into the exhaust, that gravity may free the vapor of the contained water. Its diameter should also be large, decreasing the velocity of the vapor, which adds another safeguard to the tendency of priming. While the latter conditions may be easily met, the former is usually unattainable, due to the necessity of running the exhaust piping without pockets, and serving the other auxiliaries as well.

If it is desired to make water for drinking purposes, the plant described above becomes unsuitable; an independent cooling agent for the vapor being necessary. It is found in the distiller. This device is but a small surface condenser, and as usually made consists of a cylindrical shell, longer than its diameter, with openings bottom and top for the entrance and exit of the circulating water, respectively. Within are top and bottom heads, into which small vertical tubes are expanded, the circulating water flowing through them, while the vapor comes in contact with their outside surfaces, entering near the top and flowing out the bottom as water. The product is then drained to a small fresh-water tank, tested, and if found satisfactory, drained or pumped to the ship's tanks.

It is good practice to furnish two distillers, each of half capacity for every evaporator installed. This arrangement allows one distiller to be cut out, with a saving of circulating water when the evaporator is not working at its full capacity.

Advantage of connections to the flushing system is taken at times to furnish water for distiller circulating purposes, though another method is to reverse the operation, sending water first through the distillers, and thence to the flushing line by means of the same pump. The necessary vertical rise of the vapor pipe, as previously explained, is obtained by placing the distillers in a trunk way or fastening upon a bulkhead. Evaporating under pressure is resorted to when using distillers; a vacuum being neither available nor desirable. The diameter of the vapor pipe may also be reduced over that required for the plant first described.

The essentials for making pure distilled water have now been complied with, but a few modifications will be considered, which tend to a more efficient installation. The evaporator feed should be taken from the distiller circulating pump discharge, that a portion of the waste heat may be utilized. A vapor separator is a recent innovation, and if of efficient design adds materially to the output of the apparatus. It is located in the vapor pipe, between the evaporators and the distillers, preferably near the latter. The usual types of this article which are commonly in use on steam lines are not as successful on vapor pipes. In construction their diameter should be large, as compared with the vapor pipe, that the decrease in velocity may tend to precipitate the moisture from the vapor.

The entrance of the vapor is through the top, the outlet being placed on the side, also near the top, in order to reverse the direction of flow. Two or three sheets of wire gauze placed horizontally across the separator serve to catch the contained moisture at the point where the motion is practically nil. The usual gage glass and fittings, together with a drain, are provided, the latter leading to the bilge or overboard generally through a trap.

An unobstructed drain is essential to the efficient working of this apparatus. Traps when used should be regulated to discharge freely. The writer has obtained excellent results without them by discharging directly overboard; the drain valve being cracked, allowing a small portion of vapor to be continually flowing through the line.

Having passed through the separator, the vapor is lead to a "feed-water heater." The usual cylindrical shell, through which coils of pipe are inserted, is common to most of these, as other heaters. The vapor entering at the top flows around the pipes and out at the bottom; the feed being forced up through the coil in its path to the evaporator. Distillers complete the condensation of the vapor at this point, taking the vapor from the heater by gravity and discharging it to the fresh-water tank previously mentioned.

Water thus made, being devoid of air, possesses that peculiar "flat" taste so nauseating to those unaccustomed to it. This objection is readily overcome by causing an air current to mingle with the newly made water supply. The method of connecting a pipe to the distiller near the bottom is an efficient manner of accomplishing this result; a partial vacuum being produced at this point, due to the condensation of the vapor above it, insuring a constant air supply. The pipe is, of course, led to a suitable height, a return bend upon the upper end serving to prevent the entrance of foreign matter.

Testing water for its purity is done by dissolving crystals of nitrate of silver in the water, weakening the solution until one or two drops of same in a glass of fresh water will not color it. If the sample to be tested does not change to a chalky white when the solution is added, its quality is assured, but the water should not be used when discoloration takes place on the entrance of the testing solution. All samples of water taken will discolor in time if left to stand; the length of time depending upon the strength of the mixture. It needs but little practice, however, to differentiate between good and bad water. As water treated with this solution is more or less poisonous, the sample should be disposed of and not left standing or thrown into the fresh-water tank.

Pipes for carrying fresh water are commonly made of wrought iron, galvanized, rather than brass or copper, to avoid the injurious effects attributed to these metals. If the latter are used they should be tinned.

Engineers differ widely as to the proper method of operating these plants; the fact that water when needed is needed badly leads many of them to increase the output to the greatest extent. The pressure which can be carried in the evaporator coils depends, of course, upon their diameter and

thickness, as an increase of thickness leads to a slower transmission of heat, the economical limit is soon reached. In many evaporators a safety valve limits the coil pressure to 10 pounds, although the writer has raised it to 60 pounds (the test pressure of that particular coil), with a corresponding shell pressure of 10 pounds, and at these pressures almost doubled its rated capacity, furnishing thoroughly good water.

As previously explained, the vapor is drier at the higher pressures, hence the quality of the water should be easier to maintain. That the pressure is not conducive to the greatest economy of steam is, of course, plain. The proper pressure to be carried must be varied to suit the individual conditions of the plant, together with the supply needed. For economical working it may be stated that the pressure in the coils should not be greater than is necessary to produce good water. Where a vapor separator is used, this pressure may be safely lower than when otherwise.

Carry the feed water in the evaporators at a constant height and so that the top row or two of tubes is left bare; this insures drier vapor, which is a material aid to good water. When a vessel is pitching or rolling in a heavy sea, the water level may be profitably lowered even beyond this point.

A dry pipe or its equivalent should always be fitted in an evaporator, and baffle plates, especially in the horizontal types, are an aid, sometimes a necessity.

The speed of the distiller circulating pump should be such that the vapor is thoroughly condensed. If an outlet is left in the connections where the vapor, if present, will escape in view of the operator, the speed of the pump may be regulated accordingly. The common method of placing a reducing valve in the steam supply to the plant is an excellent one, making the operation almost automatic, after a preliminary regulation.

The shell pressure of the evaporator will adjust itself to the steam supply, the final indication of which depends upon the heating surfaces of the coils and their conditions as regards the amount of scale upon their surfaces. In properly designed plants this pressure should be allowed to come what it may. Throttling the vapor discharge may be resorted to, however, if an increase in the shell load is still within its safe working limits, and a higher pressure is conducive to better water.

The use of an evaporator is coincident to the deposit of salt scale, which can be reduced to a minimum, by the judicious use of the blow connection; the increase in density of the water is also not conducive to rapid evaporation. A salinometer and pot, familiar to the engineer in his tests of boiler feed water, will also determine the proper time to "blow" the evaporator. The density may be carried somewhat higher, however, 4/32 to 5/32 being not uncommon. Other engineers "blow" at stated periods, without regard to the salinometer readings.

Compounding with evaporators has been suggested for marine installations, but has not met with favor. In this process, the vapor from the high-pressure evaporator is made to take the place of the steam in the low pressure one by passing it through the coils, draining to a trap as before, and thence to the fresh-water tank in the evaporator room. Provision must be made for running each unit independent with this system, as required when scaling or overhauling one of them, adding to the multiplication of fittings. This, together with the added weight, due to the greater pressure carried in the high-pressure evaporator, is considered to more than offset the gain in economy.

It has been suggested by Lieutenant-Commander Delaney, U. S. N., that the vapor from the evaporators should be run to the main feed-water heaters and used to heat the water entering the boilers. Where the output of the plant is constant and of sufficient volume, such a scheme might be worked out to advantage, the exhaust steam now used for this purpose being displaced to the condenser direct.

THE MARINE STEAM ENGINE INDICATOR—VIII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

REDUCING MOTIONS (CONTINUED).

The principle of the inclined plane is frequently utilized for reducing motions, more especially on long-stroke paddle engines running at slow rotative speeds. Certain forms are also applicable to short-stroke auxiliaries, and recently the inclined plane, in the form of a long pitch screw, has been used on engines of moderate stroke, with speeds as high as 120 revolutions per minute.

A reducing motion of the first kind designed by Messrs. J. F. Metten and Sven P. Meurk and fitted to the inclined paddle engines of the steamship *Commonwealth* is shown in Figs. 53 to 57. Fig. 53 is a plan, and Fig. 54 a longitudinal elevation of

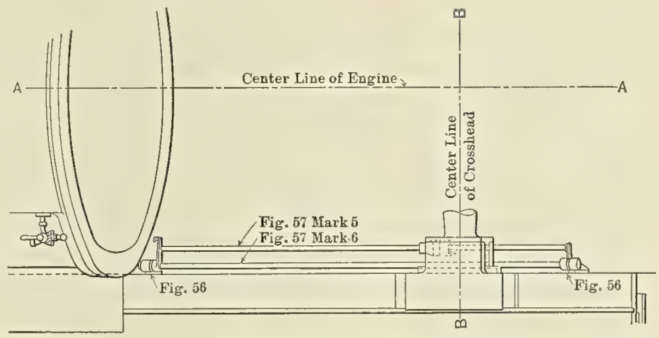


FIG. 53.

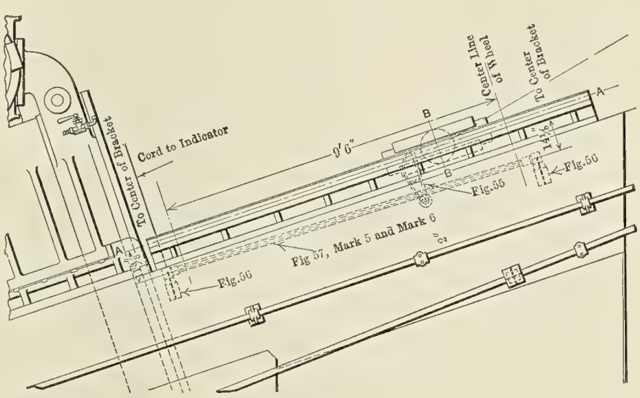


FIG. 54.

a part of the engine frame. The crank end of one of the main cylinders is seen at the left. *AA* is the center line of the piston rod, and *BB* the center line of crosshead journal. Brackets are bolted to the housing as shown. These bearings carry the shaft (mark 6) illustrated in Fig. 57. The bracket drawn in detail in Fig. 55 is bolted to the engine crosshead. This bracket carries at its lower end a 4½-inch flat-faced composition pulley. The outer bar of the rocker frame, Fig. 57 (mark 5), rests on this pulley. It will be noticed on reading the dimensions indicating the location of the center line of the rocker frame on the longitudinal elevation, that this frame is inclined relative to the center line of the piston or crosshead travel. When the engine is in motion, the inclination causes the outer bar of the rocker frame to describe the arc

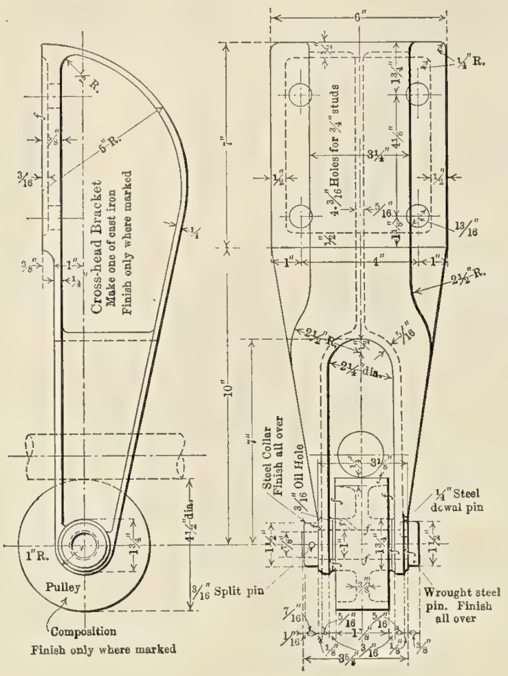


FIG. 55.

of a circle, and the pin, Fig. 57 (mark 9), on the cylinder end of the frame, of course, has a similar motion with a larger radius. The indicator end is attached to the pin and transmits the movement to the paper-drum. The weight of the frame keeps it in contact with the pulley on the crosshead bracket and takes up all back lash. This mechanism is not absolutely

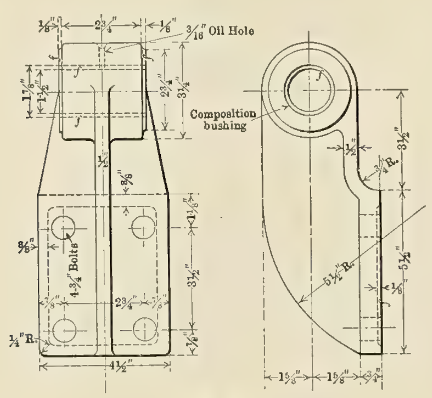


FIG. 56.

correct, owing to the necessary angularity of the cord when in certain positions, but as the cord length on this particular gear is about ten times the radius of the arm, the error is almost, if not quite, negligible. This gear is, of course, only suitable for very slow rotative speeds.

On smaller engines turning at higher speeds the device shown in Fig. 58 is sometimes found. The swing of the bell crank *B* is adjusted to the indicator by altering the inclination of the slide *A*. This mechanism also lacks precision, due to cord angularity. If *A* and *B* are not connected by a pin and slot, a recoil spring should be fitted to assist the indicator drum spring in keeping the parts in contact.

The principal part of the screw-gear reducing motion mentioned at the beginning of this section consists of a bar or shaft very similar to the bar attached to the tool head of a gun-rifling machine. This shaft is mounted in suitable bearings, with its center line parallel to the line of stroke and close

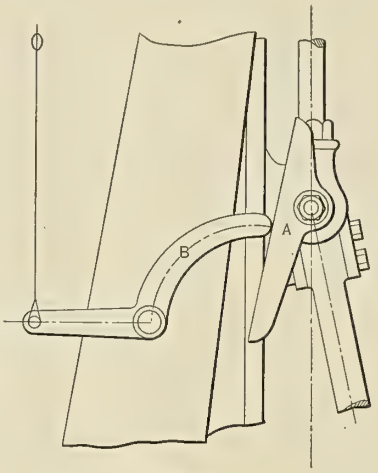


FIG. 58.

to the crosshead. Thrust blocks are fitted at one or both ends. A spiral groove of uniform twist is planed in this shaft with a pitch of, say, thirty times the diameter of the shaft. A bronze nut or sleeve slides on the shaft. This sleeve is so fastened to the crosshead that it cannot revolve and is provided with a feather or helical key, which slides in the groove in the shaft. The crosshead in its forward and backward motions causes the shaft to rotate first in one direction and then in the other. A suitable wheel or drum on the end of the shaft transmits its motion through a cord to the indicator in the usual manner. This mechanism gives a correct reduction. This shaft is somewhat difficult to machine, but if the reader will consult any good work on gunnery he will find there an interesting description of the methods used in making rifling bars, and these will apply to a job of this kind.

Another series of movements which are very handy for temporary use on slow-moving machines may be rigged with pulleys and cords. Suppose that it is desired to indicate a pump having a stroke of 8 inches. Take a single pulley and connect it as shown in Fig. 59. The pull of the indicator drum spring is supported by two cords, and the velocity ratio is 2 to 1. That is, if the pump has a stroke of 8 inches, the single cord leading to the drum will move 4 inches. If the stroke of the machine is 11 inches, a "gun tackle" can be mounted as in Fig. 60. The tension of the drum spring is here supported

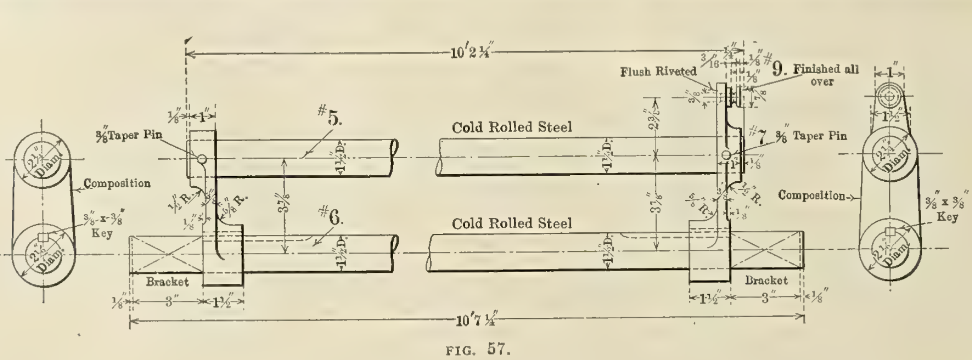


FIG. 57.

by three parts of the cord, the velocity ratio is 3 to 1, and with a stroke of 11 inches the cord will have a travel of 3 2/3 inches. The different velocity ratios possible with pulleys are almost infinite, and the reader will find no difficulty in devising a combination to suit his purpose. Care should be taken to have the pulleys as light in weight and as free from friction as possible, and where more than one set of sheaves

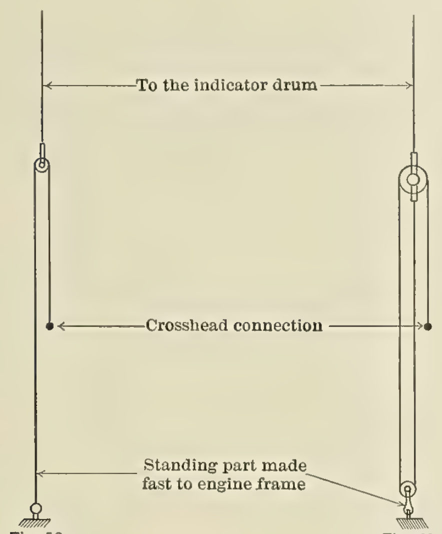


Fig. 59 Fig. 60

is used they should be of such diameter that the cords may all be parallel. Pulleys of different diameters are shown in Fig. 60. These motions will all be accurate if the cords are parallel with each other and with the line of stroke of the engine.

The lever mechanism in its various forms, which is without doubt the reducing motion *par excellence* for vertical propelling engines, will be considered next.

(*To be Continued.*)

STEAMSHIPS BEAR AND BEAVER.

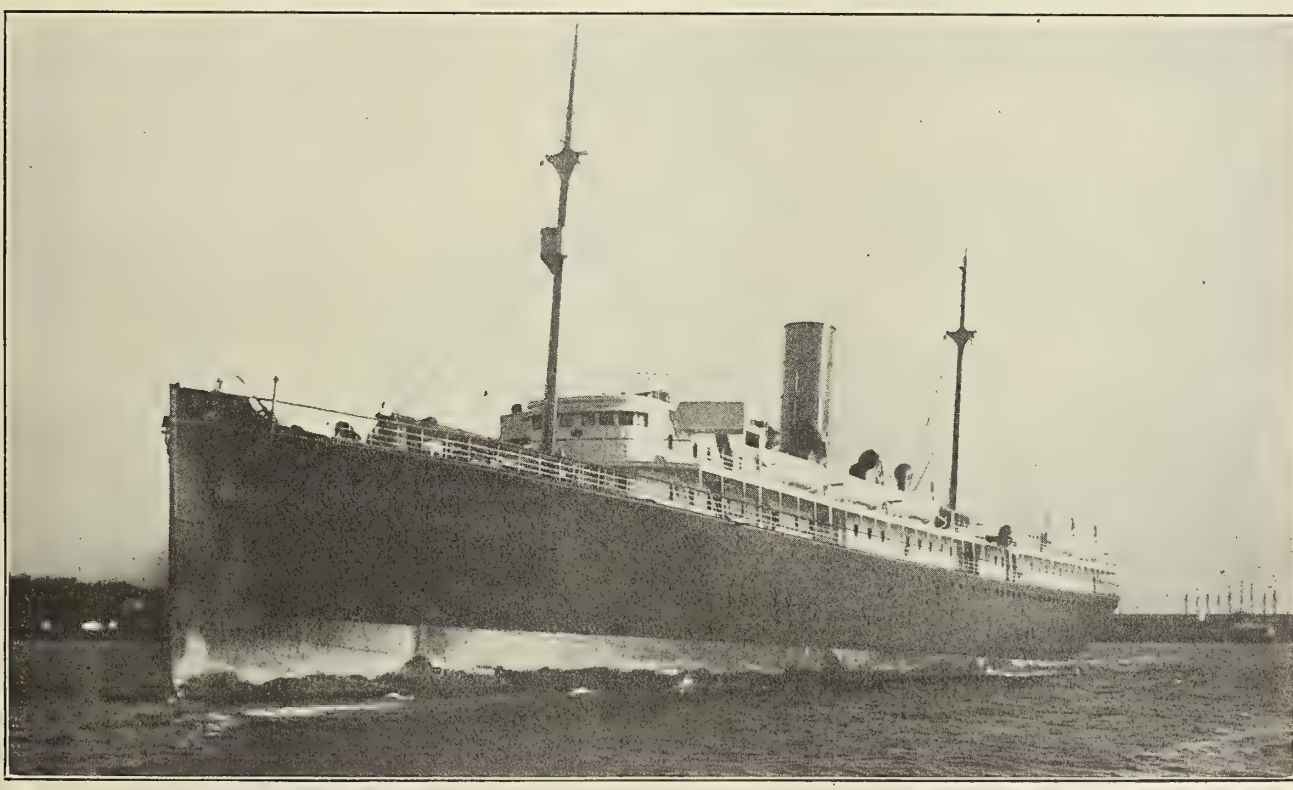
Two steel passenger and freight steamships have just been completed by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., for the San Francisco & Portland Steamship Company. These ships have been named the *Bear* and *Beaver,* and are both of the following dimensions:

Length over all, about	380 feet
Length, after-side of stem to fore-side of rudder post	364 feet
Beam, molded	47 feet
Depth, molded, to hurricane deck	34 feet
Depth, molded, to main deck	26 feet
Load draft	19 feet 6 inches
Tonnage, gross	4,100
Speed, loaded	15 knots

The vessels are steel hull, single screw, passenger and freight steamships of the hurricane-deck type, with a straight stem and semi-elliptical stern, and are schooner rigged, with two steel pole masts. There are complete lower, main and hurricane decks, and two tiers of deck houses above the hurricane deck. There is also an orlop deck in Nos. 1 and 2 holds, a promenade deck over the houses on the hurricane deck, and a flying bridge at the level of the top of the promenade deck house. A complete double bottom is fitted, and the vessel is subdivided into compartments by five watertight bulkheads.

Accommodations for 276 first class passengers are provided in ninety-two staterooms of three berths each, located on the main deck aft of the machinery, and in houses on the hurricane and promenade decks. The staterooms on the main deck are arranged generally in sections of four rooms each, with alcoves between the sections; all staterooms in the deck houses are outside rooms.

The main dining-room, with a seating capacity for 162 people, is located on the main deck aft of the engine casing, and the main stairway connecting the dining-room and a social hall above is located on the after side of No. 3 hatch.



SINGLE-SCREW PASSENGER AND FREIGHT STEAMSHIP BEAR.

A large smoking room is fitted on the promenade deck.

Accommodations for second class passengers are provided on the lower deck forward, with berths for eighty-seven men and eighteen women.

The propelling machinery consists of six return-tube Scotch boilers, one vertical donkey boiler, triple-expansion engines with cylinders 31, 50 and 84 inches diameter by 54-inch stroke, and one surface condenser independent of the engine framing.

The main valves for the high-pressure and medium-pressure cylinders are of the piston type, and the valves for the low-pressure cylinder are of the flat type. The valve gear is of the Stephenson link-motion type, with double-bar links.

The six main boilers are each 13 feet 6 inches diameter by 11 feet 6 inches long, with three corrugated furnaces and separate combustion chambers. The working steam pressure is 190 pounds per square inch. The boilers are fitted for burning oil fuel, with steam atomization.

The vertical donkey boiler is 6 feet 6 inches diameter by 11 feet high, built for 190 pounds steam pressure and arranged to burn either coal or oil.

The vessels have combined steam and hand-steering gear, with a steering engine of the Sickles type located on the main

ARRANGEMENT OF LIFE BOATS WITH WELIN QUADRANT DAVITS ON THE PROMENADE DECK.

deck forward. Auxiliary steering gear of the right and left-hand screw type is directly attached to the rudder stock.

There is a steam windlass with attached capstan forward, the windlass being located on the main deck, and the capstan on the hurricane deck. There is also a steam capstan on the hurricane deck aft.

An electric plant consisting of one 15-kilowatt and one 25-kilowatt generating set is located in the lower engine room, and there is an 18-inch searchlight on the navigating bridge.

Welin patent boat davits are provided for handling the life boats, the latter all being located on the promenade deck. This installation, as shown by the illustration, presents a neat, yet substantial and business-like appearance, taking up a minimum amount of space. Double stands have been used between the boats in order to save deck space.

The *Bear* was launched on Oct. 16, 1909, and the *Beaver*, Nov. 27, 1909.

The trial trip of the *Bear* was run on Jan. 10, off the Virginia Capes, during which a speed of 16 knots was attained, the engines indicating 4,500 horsepower at 86 revolutions. Oil fuel was used on the trial.

The *Bear* left the latter part of January for the Pacific Coast, with a cargo of steel and other freight; and the *Beaver* was completed early in February. The contract time for building the *Bear* was seven months, and she was delivered four days ahead of this time, thus netting her builders a bonus, besides upholding their well-earned reputation for prompt and speedy work.

BOILER ATTACHMENTS AND FUNNEL DRAFT.

BY LIEUT. H. K. SPENCER, U. S. R. C. S.

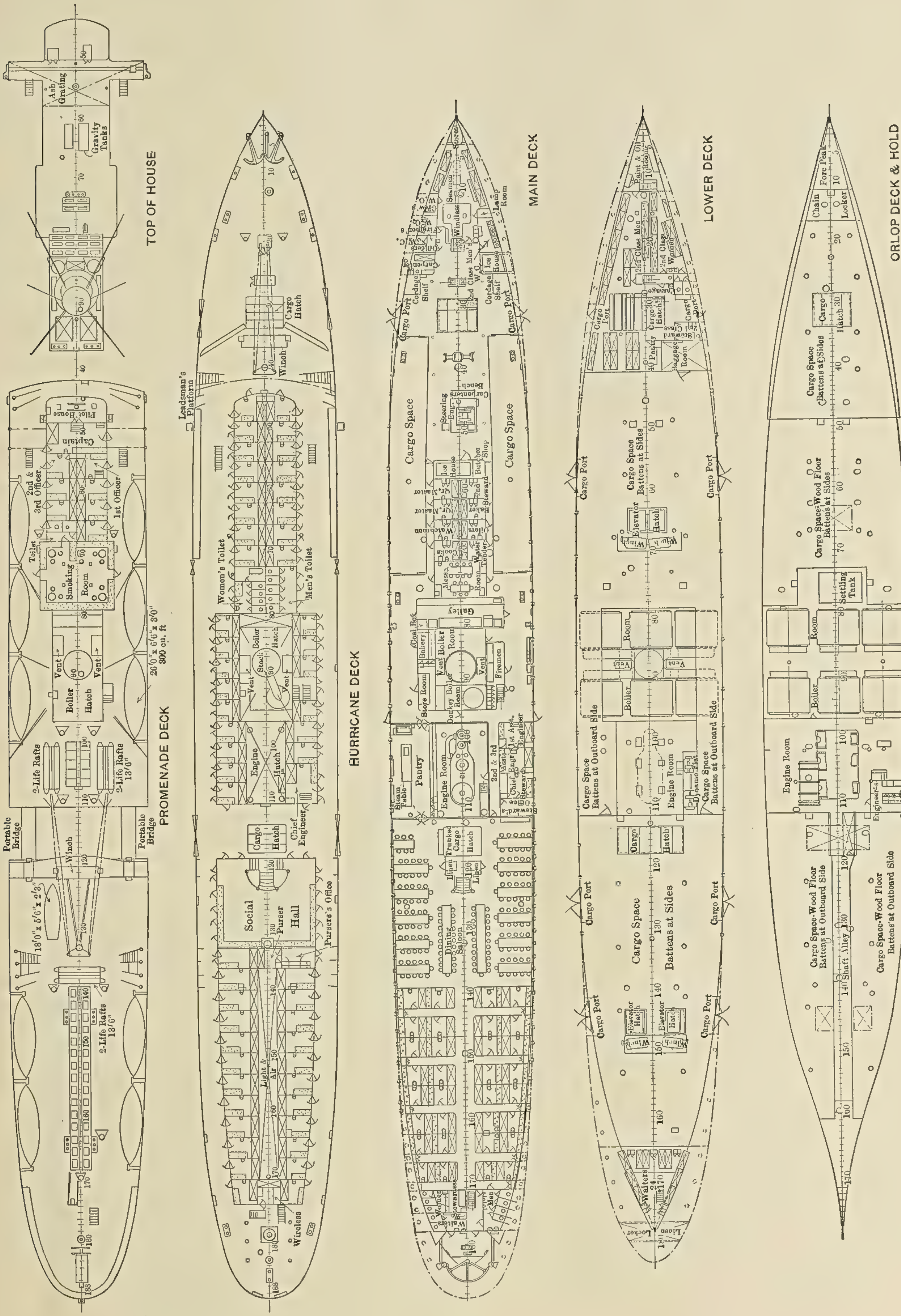
Assuming that the proper grate area and heating surface have been assigned to boilers designed to furnish a required amount of steam at a certain pressure; that the thickness of the shell plates has been determined, the riveting designed for the different styles of joints to be used in putting the boiler together, the bracing arranged and its strength calculated, the next consideration will naturally be the attachments necessary to the operation of the boilers.

A steam dome, or drum, is no longer considered necessary in order to get dry steam from a boiler. That attachment is done away with by providing a dry pipe leading from the stop valve opening lengthwise, inside the boiler, and as high as possible. Its sectional area must be at least as great as the area of the stop valve opening, and through the upper side slits are cut, or holes drilled, having an aggregate area of at least the cross-section of the pipe, and they are sometimes given an aggregate area of as much as one and one-half times that. The free end of the pipe is closed.

While there are several methods and many rules for determining the size of the safety valve, any one of which may give a valve of sufficient size to relieve a given boiler of all the steam it will make when fired to its full capacity, it must, as a minimum, be of a size determined by the rules of the United States Steamboat Inspection Service. That law provides that, if loaded with a weight acting directly, or through a lever, the safety valve must be given ½ square inch of area for each square foot of grate surface in the boiler, and if spring loaded, 1/3 of a square inch of area for each square foot of grate surface. If the diameter of the single valve obtained by the above rule is greater than 5 inches, two valves must be used, each having an effective area of at least one-half that of the single valve. Means, independent of the steam pressure, must be provided for raising each valve from its seat to a height equal to one-eighth the diameter of the valve opening.

The main stop valve and steam pipe should be given such size that the velocity of the flow of steam through them will not exceed 6,000 feet per minute. When there are two or more boilers, the aggregate area of their stop-valve openings should exceed the area of the main stop valve opening by about 25 percent, as should also the aggregate sectional area of the pipes connecting the different boilers to the main steam pipe. All bends should be made as long and easy as possible, and pockets, where water might accumulate, must be avoided. The inevitable expansion and contraction of the piping under change of temperature must be taken care of. Very often the bends in the branch pipes from the different boilers are considered sufficient to safely take the expansion there, but with the main steam pipe it is very seldom that the bends can safely be relied upon for that duty, and an expansion joint of some kind must be provided. When an expansion joint is used, the sections each side of the joint should be securely anchored to the deck from their further ends; that is, in such a manner that none of the thrust of expansion comes on the fittings at the ends of the section of piping in which the expansion joint is placed.

For boiler stop valves, the writer's preference would be heavy, angle, or globe valves, closing toward the boiler, and so designed that the stems can be packed when the valves are wide open. The way valves should be of a similar design,



DECK PLANS OF THE STEAMSHIPS BEAR AND BEAVER.

then all can be packed, whether the boilers are under steam or not.

The connections for the water columns should be ample, not less than ½ inch. Cocks, instead of valves, should be used, and placed on the boiler at each end of the pipe, and provision made for keeping the connections clear, both by blowing out and mechanically. A number of excellent devices are on the market for automatically closing the water and steam-gage glass connections when the glass breaks. The use of these devices eliminates some danger and considerable annoyance.

The surface blow should be larger than the bottom blow, and of a size sufficient to create a current toward the scum pan, when the blow-off valve is opened. The sea valve, to which this pipe connects, should be of the same size. A branch should be taken from the bottom blow pipe to the donkey pump, to be used as a suction for pumping out the boiler, so that it can be allowed to cool before emptying for cleaning. Another branch, giving the injector suction through the bottom blow should be arranged, so that the injector can be used for circulating and heating the water in the boilers before lighting fires. A drain cock should be fitted to the bottom of every boiler.

The main feed pipes should be of such diameter that the velocity of flow through them does not exceed 300 feet per minute, and for small pipes, 2 inches and under, the figure should be 200 feet per minute and less. The feed checks are best of large diameter and small lift. A stop valve should be placed between the check and the boiler. The feed water should be led by an internal feed pipe, always below the water level, to a part of the boiler where there is a decending current, or to the bottom of the boiler.

Even when mechanical draft is used, the smokestack, or funnel, should be proportioned to enable the boilers to steam at very nearly their full capacity, in case of failure or accident to the artificial draft apparatus. The smokestack is the only means of creating a draft that does not require additional apparatus and attention.

The amount of oxygen required to effect the combustion of 1 pound of carbon is 2 2/3 pounds, or 12 pounds of air. It is found in practice, however, that more than that is required to effect complete combustion, and that the quantity depends upon the nature of the draft. With artificial draft about 18 pounds of air are required per pound of coal, and with natural draft about 24 pounds. The weight of the products of combustion, with natural draft, then is, $24 + 1 = 25$ pounds per pound of coal burned on the grates, and the volume of the mixed air and products of combustion may be considered the same as that of the air supplied the furnace when at the same temperature. One pound of air, at 32 degrees F., has a volume of 12½ cubic feet, and 24 pounds, the amount necessary to consume 1 pound of coal completely, would have a volume of 300 cubic feet. At any other temperature than 32 degrees F., the volume will equal that at 32 degrees multiplied by the ratio of the absolute temperature of the new temperature to the absolute temperature of 32 degrees F., so at a temperature of, say, 500 degrees F., the volume would be $300 \times (500 + 461) \div (32 + 461) = 585$ cubic feet.

The difference in the weight of a column of outside air of the same height as the funnel above the lowest fire bars, with a cross-section equal to that of the funnel and the column of hot gases within the funnel is the measure of the force that produces the draft. Let T_{32} be the absolute temperature at 32 degrees F., T_1 the absolute temperature of the air outside the funnel, T_2 the absolute temperature of the gases inside the funnel, V_{32} the volume at 32 degrees F. of air supplied per pound of fuel burned on the grates, and H the height of the funnel in feet above the lowest grates. A cubic foot of air at 32 degrees F. weighs $1 \div 12½ = .08$ pound, therefore $.08\ (T_{32} \div T_1)\ H$ equals the weight of a column of air outside the funnel of a height equal to that of the funnel, and with a cross-section of 1 square foot. The weight of a corresponding column within the funnel is

$$\left(.08 + \frac{1}{V_{32}}\right) \frac{T_{32}}{T_2} \times H = \left(.08 + \frac{1}{300}\right) \frac{T_{32}}{T_2} \times H = .0833 \frac{T_{32}}{T_2} H$$

The force of the draft, that is, the difference of pressure within and without the funnel, is measured with a water syphon gage, which is simply a glass "U" tube, used with one end open to the air, and the other connected to the funnel. In use, it is filled about half full of water, which, when the connection to the funnel is opened, shows at different levels in the two legs of the "U" tube, and so indicates the difference of pressure within and without the flue. The difference in level in the two legs, measured in inches, and expressed as "inches of water," is the common measure of the intensity of draft. A column of water 1 inch high gives a pressure of 5.203 pounds per square foot, so, if the draft pressure per square foot be multiplied by $1 \div 5.203 = .1923$, it will give the intensity of draft expressed in inches of water; that is, the intensity of draft $= h = .1923\ (.08 \times T_{32} \div T_1 - .0833 \times T_{32} \div T_2)\ H$. The draft intensity in practice varies from .3 to .6 inch of water, according to the rate of combustion and the size of the steamer, and is sufficient to burn any of the coals ordinarily used for steam-making.

T_{32} is a constant, $= 32° + 461° = 493°$ absolute temperature, so the last equation can be rewritten $H = h \div (7.585 \div T_1 - 7.897 \div T_2)$. Assume the conditions, $T_1 = 521°$, $T_2 = 861°$, which are, respectively, the absolute temperatures corresponding to 60 degrees F. and 400 degrees F., and that a draft of .4 inch of water is required, then $H = .40 \div (7.585 \div 521 - 7.897 \div 861) = 74.21$ feet, which is the height that must be given a funnel to produce a draft of .40 inch.

Considering the cross-section of the funnel, it is evident that it should not be less than the total cross-section of all the tubes of all the boilers connected to it, as a contraction of the stream of hot gases, after leaving the tubes, could not be otherwise than detrimental to the draft.

It is generally stated that the power of a chimney to produce draft varies as the square root of the height, or, as one writer states it: (Holmes—*The Steam Engine*) "Then, since 1 cubic foot of air at 32 degrees F., or T_{32}, weighs $1 \div 12½ = .08$ pound, therefore $H\ (.08 \times T_{32} \div T_1)$ is the weight in pounds of a column of outside air of the height of the chimney standing on an area of 1 square foot. The corresponding volume within the chimney weighs $H\ (.08 + 1/V_{32})\ T_{32} \div T_2$ pounds, and the difference between these two weights is the pressure in pounds per square foot of chimney section which produces the draft. A column of hot gas equal in weight to this difference is called the head of the chimney, and, just as in hydraulics, the velocity of discharge of water from a full vertical pipe is proportional to the square root of the height of the pipe, so in the case of a chimney, the velocity with which the air would flow, if unimpeded, into the bottom of the chimney, is also proportional to the square root of the height of the head. The height of the head, reckoned in feet of hot gas, is found by dividing the weight of a column of external air as high as the chimney, as found above, by the weight of 1 cubic foot of the hot gas. (This gives the height of a column of hot gas weighing as much as the column of external air.) If we subtract from this the height of the chimney, the difference is the height of the head."

The motion of the hot gases up the funnel may or may not

be accelerated; however, it is reasonable to conclude that the retardation, due to gravity, loss of temperature and friction inside the funnel of the upward moving volume of heated gas, is compensated by the constant pressure or positive accelerating force maintained in the ash-pit, and that, therefore, the motion is uniform. The total pressure maintained in the ash-pit to force the air through the grates and the mass of fuel upon them, is the difference in weight of two volumes of gas equal to the volume of the funnel; that outside the funnel at an absolute temperature T_1, and that inside the funnel at an absolute temperature T_2. The draft may then be said to be of a certain pressure per square foot of grate area, so, if the two volumes of gas under consideration do not change; that is, if the volume of the funnel is kept constant, the total pressure to produce draft is not changed, and the draft pressure per square foot will, with equal grate areas, also remain unchanged, and consequently the rate of combustion will remain the same. Hence, it follows that the height of a funnel may be decreased and its cross area increased without changing the draft pressure per square foot of grate surface, so long as the volume is kept constant. As it would be detrimental to the draft to make the sectional area of the funnel less than the sectional area of all the tubes of all the boilers connected to it, the unit in designing a funnel may then be taken to be that one having a cross-section and height sufficient to give the desired force of draft, then, if it is desired to use a shorter stack and not change the force of draft and the rate of combustion, the height may be reduced to a minimum, keeping the volume constant.

There seems to be some advantage gained in making the sectional area of the funnel greater than the cross area of all the tubes of all the boilers connected to it, and, at the same time, so reducing the height as to maintain the condition of constant volume. The maximum sectional area that can advantageously be assigned to a funnel would appear to be that equal to the net area for draft through the grates and the mass of fuel upon them. The corresponding height, keeping the volume constant, would then be the minimum.

Suppose that the desired force of draft is .40 inch of water, and that the boilers connected with the funnel have a total grate area of 200 square feet, and that the sectional area of all the tubes of all the boilers is equal to one-sixth of the total grate area, or 33.33 square feet, which is also the sectional area of the stack to be used as a unit, so its diameter will be 6.52 feet. The necessary height of chimney to produce a draft of .40 inch, assuming that the mean temperature of the gases inside the stack is 400 degrees F., was found to be 74.21 feet, so the volume of any chimney to maintain the required draft must never be less than $74.21 \times 33.33 = 2,474$ cubic feet. The area of grates is 200 square feet, and the area of the openings between the bars will be about one-half of this, and the area for the passage of air through the mass of fuel on the grates will be about one-half of that, so the greatest sectional area that should be given the stack is $200 \times .5 \times .5 = 50$ square feet, which would make the minimum height $2,474 \div 50 = 49.48$ feet; that is, the stack should be given that height above the lowest grates, and a diameter of 7.98 feet.

If it is considered that a higher stack, say 65 feet, would keep the decks more free of cinders and present a better appearance, then it should be given a sectional area of $2,474 \div 65 = 38.06$ square feet, and its diameter would be about 7 feet. A draft of .40 inch of water is sufficient to burn ordinary steam coal at the rate of about 18½ pounds per hour per square foot of grate surface, and a stack 65 feet high and 7 feet in diameter is large enough to furnish sufficient draft to burn coal at the rate of 18½ pounds per hour per square foot on the grates of boilers having a total grate area of 200 square feet, an area sufficient for boilers supplying steam to a triple-expansion engine of 2,000 indicated horsepower.

The smokestack as designed has a volume of $2,474 \div 200 = 12.37$ cubic feet per square foot of grate of all the boilers connected to it. It has been stated that the unit to be used in designing a smokestack is that one having a sectional area equal to the area for draft through all the tubes of all the boilers connected to it, and a height sufficient to give the desired force of draft. That height having been obtained, the necessary volume of stack has been determined, and the height and diameter can be varied, keeping the volume constant, to suit the conditions of appearance, etc.

In the case considered above, the ratio of the grate surface to the area for draft through the tubes, which area is called the calorimeter of a boiler, was taken to be 6 to 1, but in practice this ratio varies from 5 to 8, so it is seen that boilers having the same grate areas, but different calorimeters, would have different sizes of funnels if the above method was followed exactly. The power of a boiler is principally fixed by its ability to burn coal, so, if the grate is of ample size, and the smokestack of sufficient height and sectional area, the principal remaining factor affecting the boiler's ability to burn coal is the area for draft through the tubes. Ratios of grate surface to calorimeter of 6 and 7 to 1 are very common; better results being obtained with the lower ratio, so it is assumed that, in all cases, the ratio is 6 to 1, then the unit volume of smokestack will be $H \times (G.\,S. \div 6)$ cubic feet, where $G.\,S.$ is the grate area in square feet. The volume of the funnel per square foot of grate will be $H \times (G.\,S. \div 6) \div G.\,S. = H/6$ cubic feet, and the following table is calculated from the equation $H = h \div (7.585 \div T_1 - 7.897 \div T_2)$, assuming that the average temperature of the stack is 400 degrees F., and that the average temperature of the outside air is 60 degrees F. Taking the net area for draft through the grates and the fuel upon them to be $G.\,S. \div 4$, the least allowable height for the stack would then be two-thirds that given in the table:

h = draft in inches of water.	H = height of stack for draft, h.	Volume of stack per sq. ft. of grate.
.30	55.68	9.28
.35	64.96	10.83
.40	74.21	12.37
.45	83.52	13.92
.50	92.80	15.47
.55	102.10	17.02
.60	111.40	18.57
.65	120.70	20.12
.70	129.90	21.65
.80	148.50	24.75
.90	167.00	27.83
1.00	185.60	30.93

The height of stack is given in feet, and the volume per square foot of grate in cubic feet.

The above method will be applied to an actual case, a steamer carrying freight and passengers on the Atlantic Coast. In service, this steamer regularly, and without any approach to forcing, burns, with natural draft, between 16 and 17 pounds of coal per hour per square foot of grate surface, a rate of combustion which should be maintained with a draft pressure of .30 inch of water, so, from the table, the smokestack should be given a volume of 9.28 cubic feet per square foot of grate in the boilers. The boilers have a total grate area of 182 square feet, so the volume of the stack should be $182 \times 9.28 = 1,689$ cubic feet. Taking the sectional area to be $G.\,S./6$, gives $182/6 = 30.33$ square feet, or a diameter of 6.22 feet. The height given in the table to produce a draft of .30 inch of water is 55.68 feet. The stack would then be made 56 feet high, with a diameter of 6 feet 3 inches. The actual stack is 52 feet 4 inches high, above the lowest grates, and has a diameter of 6 feet 6 inches, which gives it a volume of 1,697 cubic feet, or 9.54 cubic feet per square foot of grate surface.

As another example, take a large, high-powered vessel with watertube boilers, having a grate surface of 1,460 square feet.

This vessel burns easily, with natural draft (at a pressure of .45 inch of water) 22 pounds of coal per hour per square foot of grate. To create a draft of .45 inch requires a stack 83.52 feet high above the lowest grates, and if given a cross-section equal to *G. S.*/6, that will be 1,460/6 = 243.33 square feet. In this case, however, there are four stacks, so each will have a cross-section of 60.83 square feet, and a diameter of 8.80 feet. Each of the stacks would then be made 84 feet high, with a diameter of 8 feet 10 inches. The actual stacks are 90 feet high, with a diameter of 8 feet 6 inches, and a total volume per square foot of grate of 13.99 cubic feet.

Stronger draft is required to burn coals of the poorer qualities, and those that cannot be described as free burning than is necessary to obtain good results with the best grades of bituminous coal. The writer has in mind a vessel which with such coal as Pocahontas, does fairly well, but with coal of a comparatively low grade, her steaming qualities are far from satisfactory, as the draft is not sufficient. Not only it is difficult to maintain steam at anywhere near full power, but the economy is very low, even when steaming at what should be her most economical speed. As originally planned, this vessel was to have been provided with two funnels, but during her construction that was changed and only one fitted. The vessel has two boilers, each with a grate surface of 63 square feet, making a total of 126 square feet. The original plans called for two funnels, each 52 feet high, above the lowest grates, and with a clear inside diameter of 4 feet 6 inches. These dimensions would have provided a funnel volume of 13.13 cubic feet per square foot of grate surface, which, it is seen by referring to the above table, should give a draft pressure of .42 inch of water, a force of draft ample for burning any of the coals ordinarily used for steaming. As built, the vessel was provided with one funnel 52 feet high, above the lowest grates and 4 feet 10 inches in diameter. These dimensions provide 7.74 cubic feet of funnel volume per square foot of grate area, which should create a draft pressure of .25 inch of water. This is not sufficient to get the best results, even from the best grades of bituminous coal. The ratio of stack volume to grate area should never be such that the resulting draft pressure is below .30 inch of water, even when the best free-burning bituminous coal is to be used, and for the average coals a proportion that will produce a draft pressure of about .40 inch of water should be given to insure good results.

Considerations affecting the rate of combustion are the length of grates and the sectional area for draft below the grate bars. With short grates the fires can be worked better and with less labor, and the grates can easily be kept uniformly covered with fuel. With long grates, 6 feet and over, the fire is liable to burn into holes at the back end and permit an inrush of cold air, which deprives the other parts of the fire of their proportion of air and reduces the efficiency of the furnace. With short bars, the higher efficiency of furnace obtained is due, to a great extent, to the greater supply of air per square foot of grate admitted below the bars; that is, with a given diameter of furnace, the area at the mouth of the ash-pit is the same, whatever the length of the bars may be. It is sometimes stated that "the consumption of coal is very nearly proportional to the diameter of furnace," a statement that practice seems to verify.

A New Engineering Laboratory at Yale University

Dr. Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, has announced a gift to the school of $250,000 (£51,400) for the construction and equipment of a new mechanical engineering laboratory. The gift is from two graduates of the school of the class of 1888, Mr. George G. Mason, of New York city, and his brother, Mr. William S. Mason, of Evanston, Ill.

THE PRINSES JULIANA.

The twin-screw steamer *Prinses Juliana* was constructed at the Govan shipyard of the Fairfield Shipbuilding & Engineering Co., Ltd. She is the first of three vessels which the Zeeland Steamship Company of Flushing have ordered, and she will shortly take up the night service between Queensborough and Flushing. Her principal dimensions are as follows:

Length over all	363 feet
Breadth molded	42 feet 6 inches
Depth to upper deck	25 feet
Draft	12 feet
Indicated horsepower	8,000
Speed at sea	21 knots
Tonnage, gross	3,000

The propelling machinery consists of two direct-acting, triple-expansion, surface-condensing engines, each having four inverted cylinders, with cranks on the Yarrow-Schlick-Tweedy system of balancing. One of the low-pressure cylinders is at the forward end, and next to it is the high-pressure. Then comes the intermediate-pressure cylinder, with the second low-pressure at the after end. The cylinders are 28, 43½, 49, 49 inches in diameter, with a common stroke of 33 inches, and are designed to develop about 8,000 indicated horsepower when driving the ship at 21 knots sea speed.

The valves of the high-pressure and intermediate-pressure cylinders are of the piston type, the others are flat, and all are operated by the Stephenson double-link motion. Each engine has one condenser of steel plate with cast iron ends. The tubes are of solid drawn brass, and the tube plates of solid rolled brass. There are two circulating pumps of the centrifugal type, and two air pumps of Weir's independent monotype. There are two feed pumps of Weir's make, which draw from the feed heaters and discharge into the boilers. The two propellers have each three blades of manganese bronze, with bosses of cast steel, having zinc protectors to prevent corrosion.

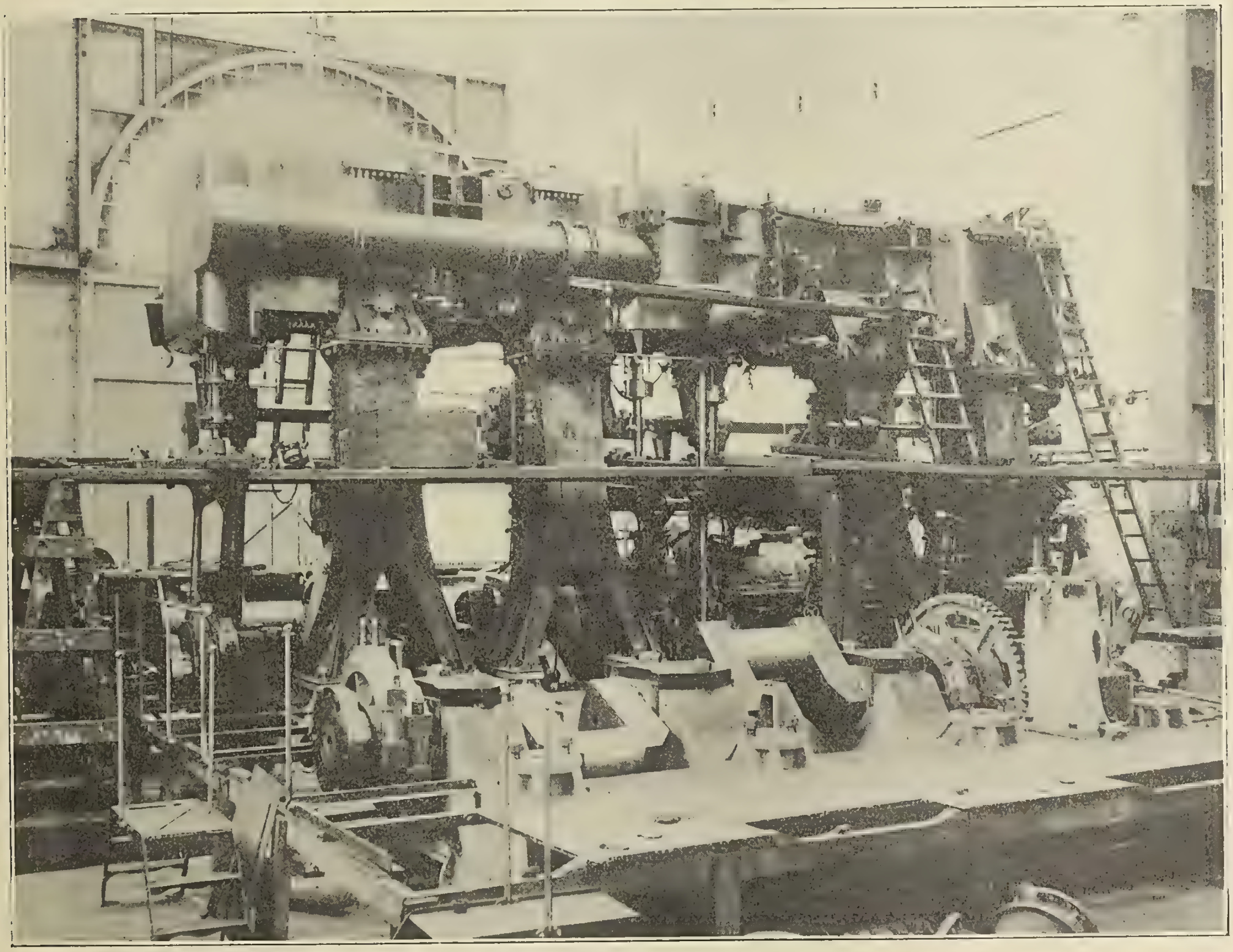
The steam generating plant consists of four double-ended boilers of the multitubular type, each designed for a working pressure of 180 pounds per square inch. They are each 15 feet 6 inches diameter and 18 feet long and are placed in two boiler rooms. All the furnaces are of the suspension bulb type, working under Howden's system of forced draft; air being supplied by four electric-driven fans.

Two See's ash ejectors are fitted for the quick disposal of ashes.

The electric generating plant consists of two sets, manufactured by Messrs. Allen, of Bedford. Each set is constructed for a continuous output of 75 kilowatts at 100 volts when running at a speed of 500 revolutions per minute.

The ship is built to Lloyd's A class for channel service, and has five decks, named in the following order: Lower, main, upper, promenade and boat deck. She is fitted with two funnels and two pole masts, and has been specially designed for the night service between Queensborough and Flushing. Provision has been made to accommodate a large number of passengers, and a special feature is the one-berth cabins, of which there are many. Passengers may enter the main stairway either on the promenade or the upper deck, according to the height of the tide at the landing stage. From the first class entrance hall the passenger goes down a broad and easy stairway to the first class dining saloon on the main deck and to the first class staterooms. The dining saloon is placed abaft the engine room. It extends the full width of ship and has seating accommodation for ninety-three. The cabinet work and fittings for the dining saloon and the first class public

TWIN SCREW STEAMSHIP PRINSES JULIANA.



PORT ENGINE OF S. S. PRINSES JULIANA IN THE ERECTING SHOP.

rooms has been designed, supplied and fitted by Messrs. Mutters & Son, of Amsterdam.

The smoke room is on the upper deck, forward, and is accessible by two side passages and a central stairway. The entrance hall on the upper deck is provided with settees and tables and forms a lounge. Immediately aft, and opening off the entrance hall, is the imperial suite of rooms. These consist of a large sitting room, a bed room, and a bath room, all of which are very tastefully finished by Messrs. Mutters. Forward there are rooms for 246 first class passengers, of which sixty will have one-berth cabins, and the others two-berth rooms. A group of two-berth cabins forward is reserved for ladies.

Aft them are berths for 110 second class passengers in rooms for two, four or six. The second class dining saloon seats twenty-eight and is on the main deck, and the second class smoke room is in a house on the poop deck.

The promenade deck is 200 feet long and forms a grand promenade for passengers, while the boat deck affords protection in wet weather. On the boat deck there are six lifeboats and on the poop deck two lifeboats. Each boat is fitted with Welin's quadrant davits. The vessel is fitted with a balanced rudder of the builder's own special type, which is worked by a steam tiller controlled from the bridge.

The anchors are worked by a powerful windlass of Clark Chapman's make.

The speed trials of the *Prinses Juliana* took place on the Firth of Clyde on Sept. 2, 1909. These consisted of progressive runs on the measured mile at Skelmorlie, commencing at 11 knots and gradually increasing until a speed of 22½ knots was attained. The sea speed test was carried out in the North Sea, and between the Hinder and the Tongue the speed obtained was 22 knots.

The Effect of Superheat on the Economy of a Marine Engine as Determined by Tests on the Steam Yacht Idalia.*

BY LIEUT. JOHN HALLIGAN, JR., U. S. N.

On Oct. 11, 12, 13 and 14, 1909, comparative tests were made of the steam consumption of the main engine, feed, circulating and air pumps of the steam yacht *Idalia*, using saturated steam and steam with from 57 degrees to 105 degrees F. superheat.

These tests were conducted by Dr. D. S. Jacobus, under the direction of Mr. W. D. Hoxie, the owner of the *Idalia*, through whose courtesy tests 3, 4 and 5 were witnessed by the writer, representing the Bureau of Steam Engineering.

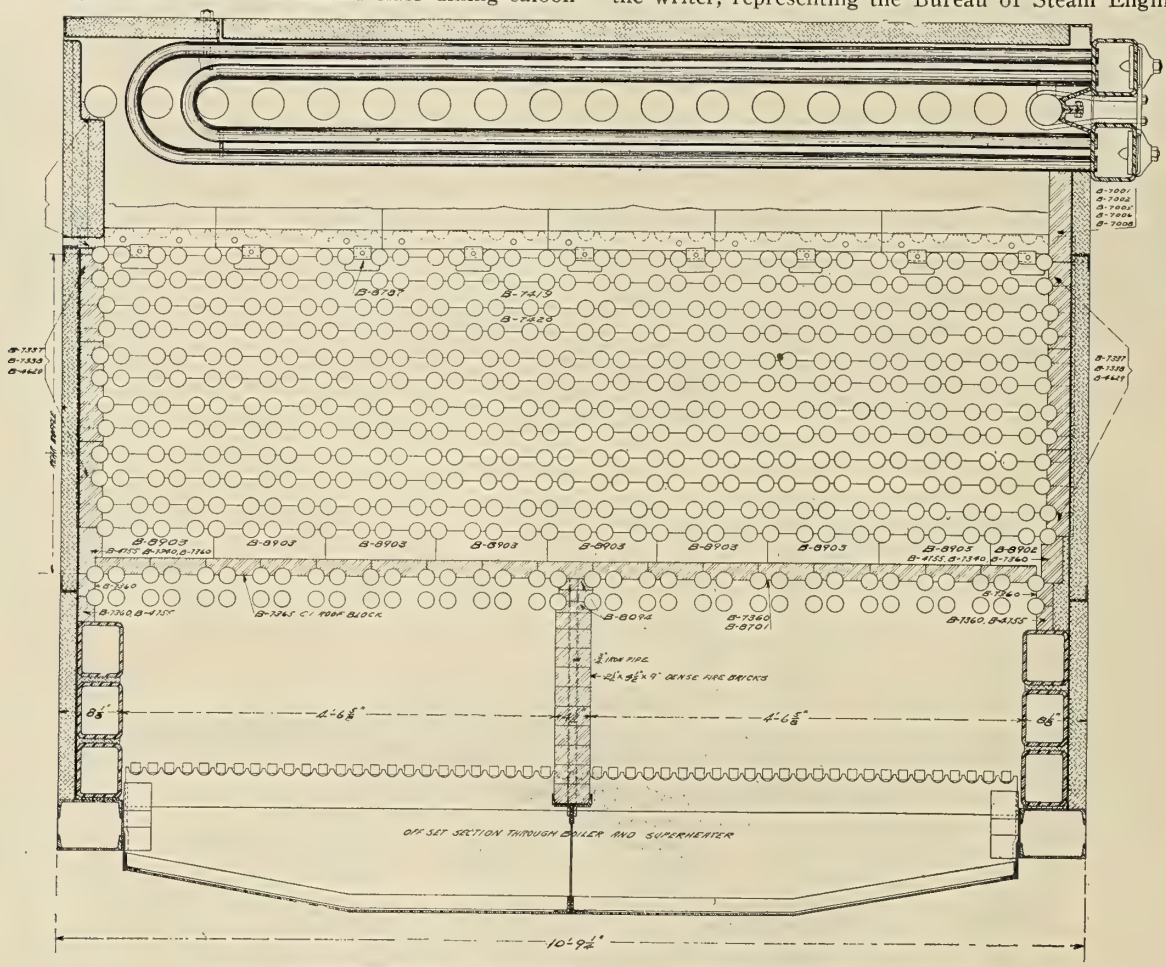


FIG. 1.—TRANSVERSE SECTION THROUGH BOILER, SHOWING LOCATION OF SUPERHEATER.

The *Idalia* is of the following general dimensions: Length over all, 178 feet; length on waterline, 140 feet; beam, 20 feet; depth, 10 feet; draft, 9 feet; gross tonnage, 201; net tonnage, 111.

She is propelled by a four-cylinder triple-expansion engine, 11½ by 19 by 22 11/16 by 22 11/16 by 18 inches stroke, the valves of which are all of the piston type.

Steam is supplied by a Babcock & Wilcox boiler, burning anthracite coal, with 65 square feet grate surface and 2,500 square feet heating surface. A superheater of 340 square feet heating surface is fitted, as shown in Figs. 1 and 2.

The auxiliaries connected with the tests are of the following dimensions: Feed pump, inches, 6 by 4 by 6; air pump (independent), inches, 6 by 12 by 8; circulating pump (centrifugal), inches, 5 7/16 by 5.

Under ordinary conditions of cruising, about 100 degrees of

* From the *Journal* of the American Society of Naval Engineers.

superheat is carried. Except in the case of the dynamo engine, all of the auxiliaries take superheated steam at full boiler pressure. The only lubricant used in the main and auxiliary steam cylinders is fine graphite mixed with water. On the main engine this mixture is introduced by means of a hand-lubricating pump fitted at the throttle, which supplies all the lubricant required for the four main pistons and their respective valves. No difficulty has been experienced in the upkeep of the plant attributable to the use of superheated steam. That the cylinders are in excellent condition is evidenced by the efficiency of the engine as shown on the tests.

The tests consisted of runs under conditions that were practically identical as regards their effect on the results. The main engines and auxiliaries were run at nearly constant speeds. The same indicators, thermometers and gages were used in all the tests, so that the results are strictly comparable.

The steam used by the main engine, the feed, the air and the circulating pumps (all of which are independent) was determined by weighing the condensed steam discharged from the surface condenser, it being pumped from the hot well into a weighing tank mounted on platform scales, from which it was discharged into a feed tank. Temperatures and pressures were recorded at intervals of 15 minutes. Frequent sets of indicator cards were taken, the results of all of which are shown in the tables. New indicators with outside springs were used. The gross and tare weights of each tank full of water were measured, and the net weight of the partially filled tank at the end of each hour was recorded.

The dynamo engine was not run during the tests. The only other auxiliaries—the blower engines—exhausted into the atmosphere.

No attempt was made to record coal consumption or other boiler data, as the tests were too short to afford accurate data of this sort.

The tests were, however, of sufficient duration to give an accurate determination of steam consumption, as is evidenced by the uniformity of the hourly data. The result for any hour of the tests plots very close to the curve shown in Fig. 4.

The superheater shown in Figs. 1 and 2 was designed to provide 100 degrees of superheat; this established the upper

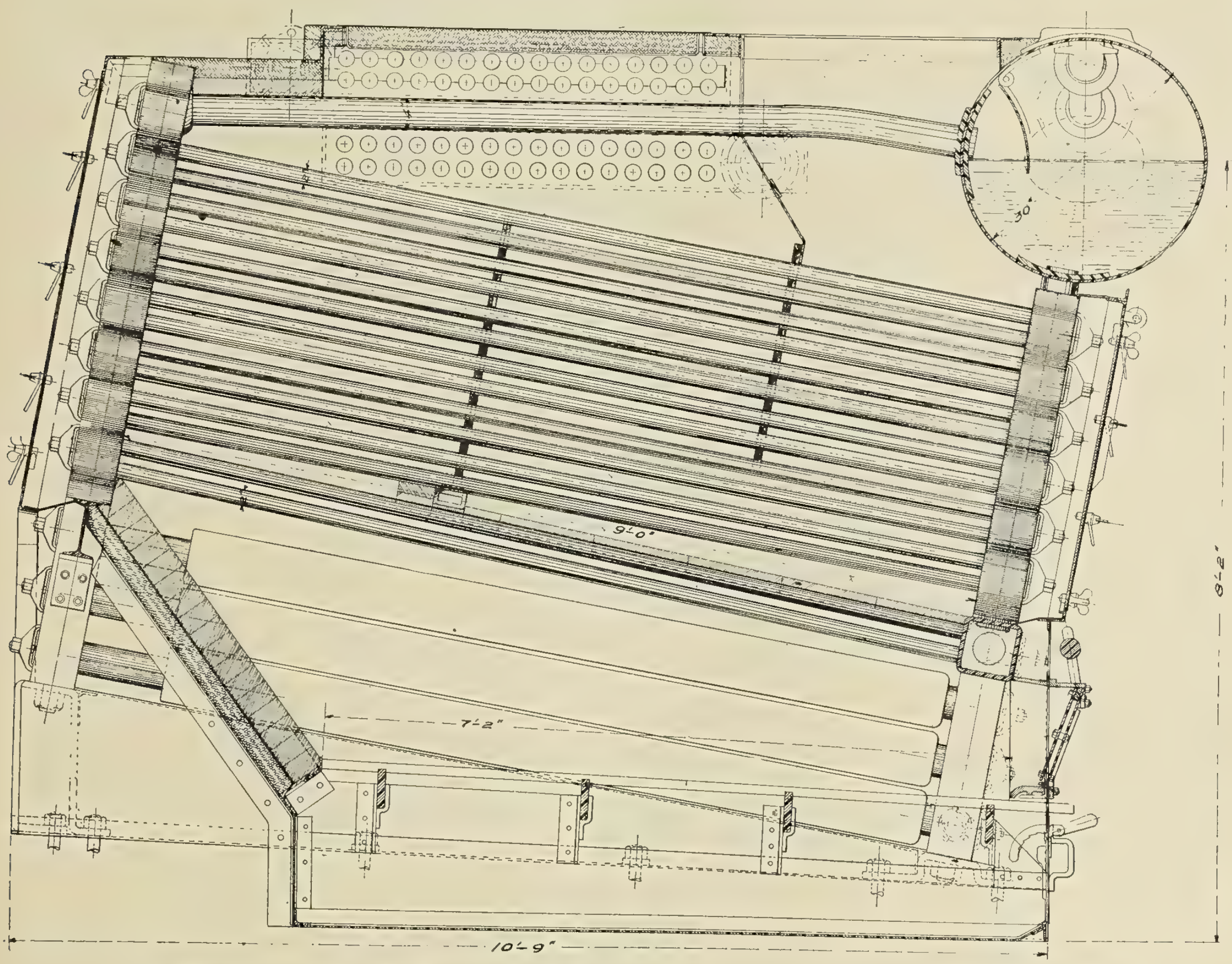


FIG. 2.—LONGITUDINAL SECTION THROUGH BOILER, SHOWING LOCATION OF SUPERHEATER ABOVE EVAPORATING TUBES.

limit of the tests. The lower degrees of superheat were obtained by mixing superheated with saturated steam, and by partly shielding the superheater from the hot gases by means of asbestos mill board. It was impossible with the means at hand to secure a lower degree of superheat than 57 degrees.

In the test with saturated steam the superheater was completely cut off from the steam line and vented to the atmosphere. The saturated steam was shown to be dry by a throttling calorimeter.

The results obtained are shown in the following tables, and, in the form of a curve, in Fig. 4. It will be noted that the water consumption of the main engine and auxiliaries was 18.3 pounds per indicated horsepower per hour with saturated steam, and 15.5 pounds when steam superheated 105 degrees was used.

Expressing these results as heat consumption per indicated

horsepower per minute we have, respectively, 365.7 and 326.9 B. T. U's. That is, the heat consumption with 105 degrees superheat is 89.4 percent of that when using saturated steam. In other words, the tests indicate that there is a net gain of 10 percent obtained by using 100 degrees F. of superheat. This may be expressed as a saving in coal of 1 percent for each 10 degrees of superheat.

57 degrees F. and 15.3 percent when superheating 105 degrees F.

The tests are directly comparable in the saving of steam due to superheating, as the work done by the main engine and its auxiliaries was practically constant, the exhaust steam being condensed and carefully check-weighed hourly throughout the duration of the trials.

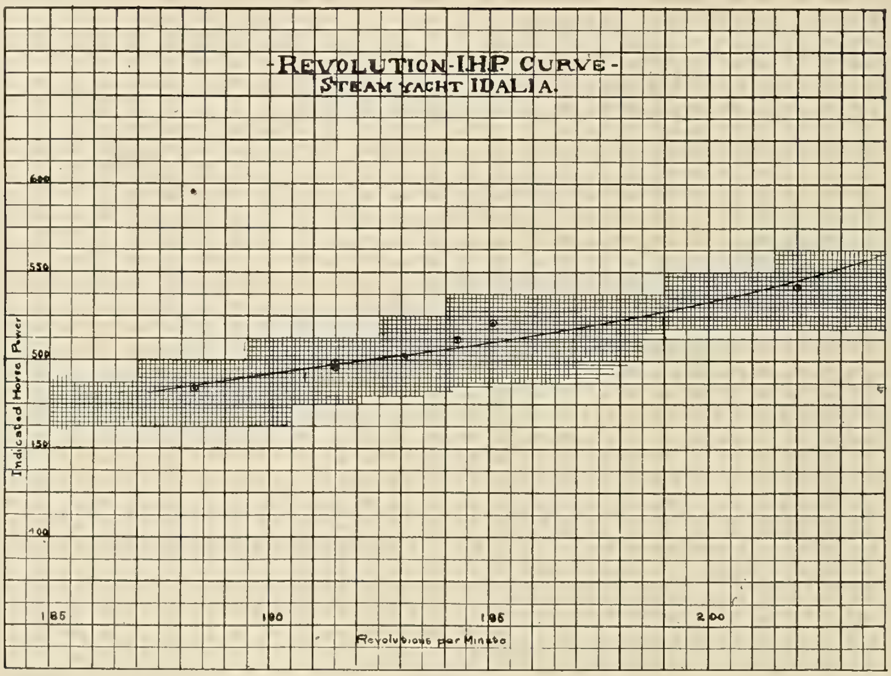
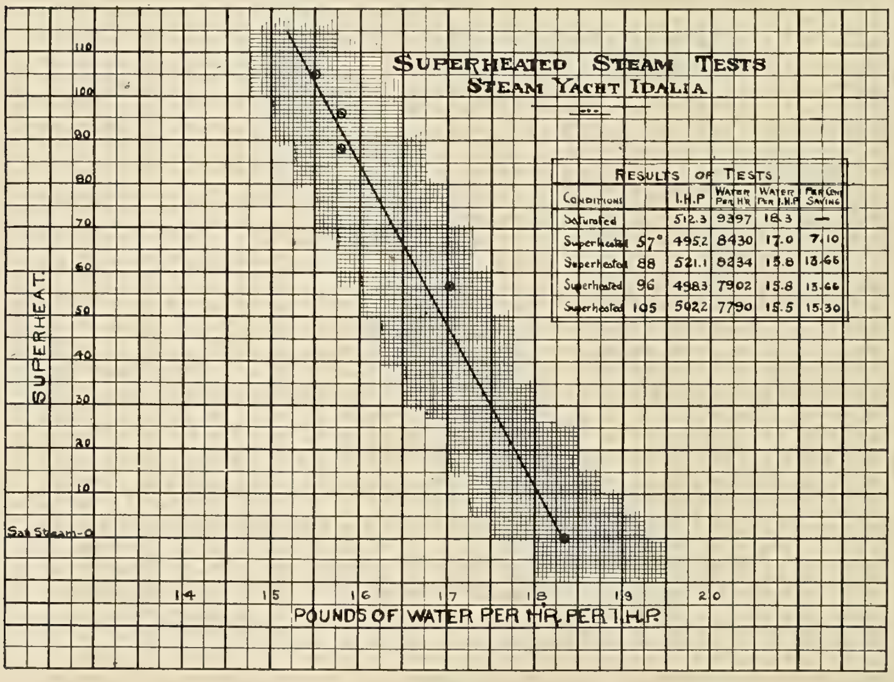


FIG. 3.



Conditions		I.H.P	Water Per Hr	Water Per I.H.P	Per Cent Saving
Saturated		512.3	9397	18.3	—
Superheated	57°	495.2	8430	17.0	7.10
Superheated	88	521.1	8234	15.8	13.66
Superheated	96	498.3	7902	15.8	13.66
Superheated	105	502.2	7790	15.5	15.30

FIG. 4.

Note.—The foregoing tests conclusively prove the economy resulting from the use of superheated steam. In the following table, "Summary of Tests," is found the actual saving in steam per indicated horsepower for different added increments of superheat. These results are plotted in Fig. 4, and the gross saving is found to be 7.1 percent when superheating

Where there are relatively large losses from condensation, the gain due to the use of superheat will be even higher than here shown. This will be the case when running at low powers; so that for the ordinary cruising speeds of naval vessels, a gain of about 12 percent in economy may be expected with 100 degrees superheat.

SUMMARY OF INDICATOR CARDS.

Saturated Steam.

Date, 1909.	Time.	Card.	Mean Effective Pressure.				Water per Hour.
			H. P.	I. P.	F. L. P.	A. L. P.	
Oct. 11	2:15						
	2:30	1	80	38.0	13.0	12.0	
	3:00	2	75	37.0	12.5	11.5	
	3:15						9,177
	3:30	3	75	37.5	12.0	11.5	
	4:00	4	75	38.0	13.0	12.5	
	4:15						9,214
	4:30	5	86	40.0	13.75	13.0	
	4:45						5,101
	Averages	....	78.2	38.1	12.85	12.1	9,397

Collective indicated horsepower = 512.34.

SUPERHEATED STEAM, 57 DEGREES.

Date, 1909.	Time.	Card.	Mean Effective Pressure.				Water per Hour.
			H. P.	I. P.	F. L. P.	A. L. P.	
Oct. 14	2:30						
	2:35	1	78.5	37.0	13.25	12.25	
	2:55	2	84.0	37.5	13.25	12.25	
	3:15	3	81.0	37.5	13.00	12.25	
	3:30						8,571
	3:35	4	70.5	33.0	11.50	11.00	
	3:55	5	80.5	37.0	13.25	12.25	
	4:15	6	75.0	37.0	11.75	11.85	
	4:30						8,290
	Averages	....	78.25	36.5	12.67	11.98	8,430

Collective indicated horsepower = 495.2.

SUPERHEATED STEAM, 88 DEGREES.

Date, 1909.	Time.	Card.	Mean Effective Pressure.				Water per Hour.
			H. P.	I. P.	F. L. P.	A. L. P.	
Oct. 14	9:45						
	9:55	1	89.0	35.0	12.00	11.50	
	10:15	2	85.0	33.0	11.66	10.125	
	10:35	3	91.0	37.0	12.50	11.50	
	10:45						7,965
	10:51	4	95.0	37.0	12.50	12.00	
	11:15	5	95.0	37.0	13.65	12.60	
	11:35	6	87.5	37.0	12.10	12.00	
	11:45						8,291
	11:55	7	85.0	36.0	13.75	12.50	
	12:15	8	85.0	35.0	12.50	12.25	
	12:35	9	90.0	36.0	13.00	12.50	
	12:45						8,447
	Averages	....	89.17	36.0	12.63	11.89	8,234

Collective indicated horsepower = 521.14.

SUPERHEATED STEAM, 96 DEGREES.

Date, 1909.	Time.	Card.	Mean Effective Pressure.				Water per Hour.
			H. P.	I. P.	F. L. P.	A. L. P.	
Oct. 12	3:00						
	3:15	1	84.75	...	10.25	10.00	
	3:45	2	91.50	35.00	14.50	12.00	
	4:00						7,842
	4:15	3	93.00	33.75	...	11.00	
	4:50	4	87.50	35.00	13.50	11.50	
	5:00						7,994
	5:04	5	87.00	34.50	13.00	11.00	
	5:26	6	87.70	35.00	12.75	10.50	
	5:30						7,870
	Averages	....	88.57	34.65	12.8	11.0	7,902

Collective indicated horsepower = 498.27.

SUPERHEATED STEAM, 105 DEGREES.

Date, 1909.	Time.	Card.	Mean Effective Pressure.				Water per Hour.
			H. P.	I. P.	F. L. P.	A. L. P.	
Oct. 13	2:35						
	3:00	1	...	33.0	11.25	10.25	
	3:15	2	91.0	35.0	13.00	11.50	
	3:35						7,793
	3:38	3	95.0	35.0	12.15	10.75	
	3:54	4	92.5	34.0	12.50	10.80	
	4:10	5	95.0	34.5	12.10	10.50	
	4:29	6	92.5	35.0	12.30	10.90	
	4:35						7,863
	4:48	7	91.0	34.0	12.65	11.00	
	5:05	8	91.0	36.0	12.15	11.00	
	5:24	9	83.5	35.0	11.50	10.80	
	5:35						7,713
	Averages	....	91.4	34.6	12.17	10.83	7,790

Collective indicated horsepower = 502.15.

MARINE AUXILIARIES.

BY SIDNEY F. WALKER.

The history of the development of auxiliary machinery on board ship practically coincides with the history of the development of the marine steam engine. Since Fulton drove his first steamboat up the Hudson, and since the early steamships crossed the Atlantic, enormous advances have been made in the size of ships, in the speed at which they run, and in the economy at which they are worked. It will be remembered that in the early trans-Atlantic steamers, the *Great Western* and others, the speed was only about 5 knots, and the steam pressure only about 5 pounds per square inch. The ships were also small, and the accommodations such as would be considered in these days almost barbarous. One of the earliest advances made in steam engineering, both ashore and afloat, was the gradual increase of pressure. The 5 pounds per square inch of the *Great Western* has become 250 and 300 pounds in modern ships. The consumption of coal, on the other hand, has steadily decreased. From the 10 pounds or more per indicated horsepower of early days, the consumption has been reduced to 1¼ pounds, and in some cases less in modern steamships.

The increased size and speed of ships have demanded increased size in the engines, and as the size of the engines and the demand for coal and bunker space have increased, the requirements of economy in coal have become more and more pressing. Hence with the advances in size and speed, there has been a development of auxiliary apparatus, designed to effect economy in fuel consumption.

THE CONDENSER.

The condenser was the first apparatus applied to economize fuel on board steamships, but the condenser of the early days and that of to-day are very different pieces of apparatus. The condenser was applied very early by Watt and by others, notably the makers of Cornish pumping engines. In the early days of steamships the jet condenser was employed, because it was simpler than the surface condenser, and because it was

SUMMARY OF TESTS.

Date, 1909.	Conditions.	Pressures. Throttle.	Pressures. First Receiver.	Pressures. Second Receiver.	Vacuum.	Temperatures. Feed.	Temperatures. Hot-well.	R.P.M. Air-Pump.	R.P.M. Circulating Pump.	Revolutions per Min., Main Engine.	I.H.P. Main Engine.	Water per Hour, Total.	Water per I.H.P.	Percent Saving of Steam.
Oct. 11	Saturated	190	68.4	9.7	25.5	201	116.0	57	196	194.3	512.3	9,397	18.3	....
Oct. 14	Superheat, 57°	196	66.0	9.2	25.9	206	109.5	56	198	191.5	495.2	8,430	17.0	7.10
Oct. 14	Superheat, 88°	201	64.3	8.7	25.9	205	115.0	53	196	195.1	521.1	8,234	15.8	13.66
Oct. 12	Superheat, 96°	198	61.9	7.8	25.4	202	111.5	54	198	191.5	498.3	7,902	15.8	13.66
Oct. 13	Superheat, 105°	203	63.0	8.4	25.2	200	111.0	45	197	193.1	502.2	7,790	15.5	15.30

more easily kept in order. With the jet condenser a portion of the water coming from the condenser was employed as boiler feed, but, as will easily be understood, troubles with incrustations of salt in those days were not the least with which the marine engineer had to deal. In those days, also, and for a very long period afterwards, the air pump was driven from the main engine. In fact, the independent air pump has not entirely displaced that driven from the main engine even at this date, though its use is continually on the increase, as it makes for greater economy and, what is of more importance, for greater control of the condenser.

At the present time the surface condenser is the only one that is suitable for marine work. Like other apparatus, it has been gradually developed from very crude beginnings, as the principles upon which condensation takes place have been better and better understood, till at the present day the surface condenser is an exceedingly efficient apparatus. Even with the best form of ordinary surface condenser, however, the results obtainable are not sufficiently good for steam turbine work. It will be remembered that the great advantage which the

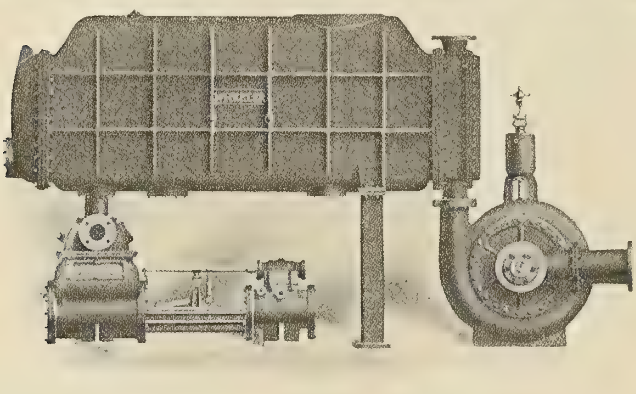


FIG. 1.—WHEELER ADMIRALTY CONDENSER WITH DIRECT ACTING AIR PUMP AND CENTRIFUGAL CIRCULATING PUMP.

steam turbine has over the reciprocating engine is the ability to utilize the steam down to very low pressures, to 28, 28½, and even 29 inches vacuum, if it can be obtained, while the reciprocating engine cannot utilize the steam much below 25 inches vacuum economically. As marine engineers know, the volume of the steam rapidly increases as the pressure falls, particularly below the pressure of the atmosphere. At 25 inches vacuum, for instance, the volume of 1 pound of steam is approximately 150 cubic feet; at 28 inches vacuum it is 350 cubic feet, and at 29 inches it is 641 cubic feet. With the reciprocating engine, the cylinders required to deal with these large volumes of steam would be very heavy, and the valve ports would also require a great deal of care in designing, and would even then probably throttle the steam. With the steam turbine, however, the whole range of pressure can be utilized, no matter how high the vacuum is. As marine engineers are aware, also, the fall of temperature utilized by the mechanical action of the steam is a measure of the efficient use of the steam, and between atmospheric pressure and 29 inches vacuum there is a difference of 130 degrees F., while between atmospheric pressure and a pressure of 250 pounds per square inch the difference of temperature is only 194 degrees F. Hence it is of enormous importance to procure high vacua with steam turbines, and this is not easily obtained with the ordinary surface condenser. The increased quantity of cooling water required is very great, the cost of pumping the increased quantity of water is also serious. Hence, auxiliary forms of condensers have been devised.

For this purpose Mr. Parsons has employed what he calls a vacuum augmenter. He found that it was necessary to increase the condenser surface per indicated horsepower, and to construct the condenser with tubes spaced wider apart than is usual, so that the steam can flow easily among them, and to submerge the lower tubes in the condensed water. The vacuum augmenter was designed to draw off the air and water from the bottom of the condenser by an application of the injector principle. The vapor and air from the augmenter condenser joins the water in the main delivery pipe leading from the condenser, and is drawn off with it by the air pump.

A further development in condensers has been made in the Contraflo, made by Messrs. Richardsons, Westgarth & Company, of Hartlepool. The principle upon which the Contraflo condenser works is that the condensation is carried out in sections. The condenser is divided into two or more divisions, the steam passing through the divisions in series, and the condensed water being drawn off from each division to the hot well as it is formed. The Wheeler Engineering Company and others have also developed forms of surface condensers, designed to give the cooling water the fullest access to the heated surfaces of the pipes on the other side of which the steam is passing, and also to make the whole arrangement compact, an important object on board ship. In the Wheeler Admiralty condenser the condenser itself is carried on pillars above a bedplate, upon which are mounted the air and circulating pumps, the two pumps being worked by a single steam cylinder. The Wheeler Company also makes combined surface condensers and feed-water heaters.

EVAPORATORS.

In order that the boiler may do its best work, the water employed must be as free as possible from dissolved salts. As mentioned above, the old plan of utilizing the water from a jet condenser would be howled out of court at the present time, because the deposit of salts upon the boiler tubes would so seriously affect the working of the boiler as to cause excessive waste and inefficiency. It is the practice in modern steamships to work with fresh water pumped into tanks provided for the purpose when the ship is in dock, and to make up the leakage that is unavoidable by the addition of the necessary quantity of pure water obtained by distillation.

There are a number of evaporators upon the market, but all of them work upon the same principle; that is, the vaporization of sea water. The usual arrangement as made by Messrs. G. & J. Weir, Glasgow; Messrs. Caird & Rayner, of Glasgow; Messrs. Richardsons Westgarth & Co., of Hartlepool; Messrs. Davie & Horne, of Glasgow, and Messrs. Royle,

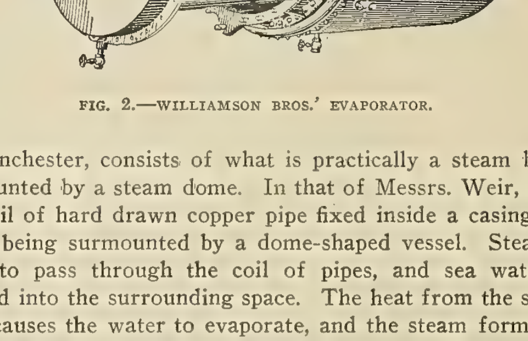


FIG. 2.—WILLIAMSON BROS.' EVAPORATOR.

of Manchester, consists of what is practically a steam boiler surmounted by a steam dome. In that of Messrs. Weir, there is a coil of hard drawn copper pipe fixed inside a casing, the whole being surmounted by a dome-shaped vessel. Steam is made to pass through the coil of pipes, and sea water is pumped into the surrounding space. The heat from the steam pipes causes the water to evaporate, and the steam formed is collected in the dome-shaped space above. In Weir's evaporator the coils are fixed horizontally. In Messrs, Caird &

Rayner's evaporator the steam coils are also fixed horizontally, but there are two sets sandwiched together. In the Morrison evaporator, made by Messrs. Richardson-Westgarth, the coils are in a vertical plane. In Messrs. Davie & Horne's evaporator, the coils are in a horizontal plane, but they are formed into a hemispherical shape, and occupy the lower portion of a spherical chamber. In Messrs. Royle's evaporator, the steam tubes are of a special "Row" pattern and are fixed vertically.

In all forms of evaporator, the question of cleaning the outside of the coils is an important one, owing to the incrustation of salt, which takes place from the sea water as the evaporation proceeds. Arrangements are made, therefore, in all of them to inspect and clean the coils. In Messrs. Royle's the bank of tubes is fixed upon the door of the evaporator chamber, and when the door is swung open, the tubes are easily accessible for cleaning. In Messrs. Weir's evaporator, the door is made to swing open, and the tubes can then be withdrawn to be cleaned. In the Morrison apparatus, the tubes are withdrawn on opening the door. In the evaporator of Davie & Horne, the arrangement is rather different. The spherical evaporating chamber is made in two halves. One half forms the door, and is lifted right away; the tubes can then be revolved upon the upper connecting tube as a pivot.

In the Williamson evaporators (Fig. 2), made by the Williamson Bros. Company, Philadelphia, Pa., the steam circulates through a nest of straight brass tubes expanded into tube heads, covered at each end by steam bonnets. The salt water circulates around the tubes in a vertical cylindrical shell. The tubes are horizontal in the bottom of the evaporator, and can readily be removed for cleaning.

A somewhat different type of evaporator is manufactured by the Griscom-Spencer Company, New York. The steam circulates in vertical spiral coils, of which there are a great number, arranged in a vertical cylindrical shell. The coils are of small diameter, seamless, drawn-copper tubing, and are joined to the headers by screwed, ground union joints without packing or gaskets. It is claimed that this constriction insures exceptional elasticity and freedom from accidents, while at the same time the coils are not subject to scale deposits.

The question of the use that should be made of the distilled water produced by the evaporators is important. It may be delivered to the low-pressure receiver of the main engines; it may be delivered straight to the condenser and carried to the hot well with the condensed water, or it may be delivered to the hot well, or feed tank direct. The last method is the most economical, as all of the water that has been evaporated is usefully employed, and the heat which is contained in the steam that has been formed is delivered to the feed water. When the steam from the evaporator is delivered to the condenser, the heat that was employed in evaporating it is practically lost, and a large portion of it is also lost when the steam is delivered to the low-pressure receiver. Messrs. Richardson-Westgarth give the difference in economy between delivering the evaporator steam directly to the feed water and to the low-pressure receiver and the condenser, respectively, as 1 to 12.3 and 16.5. In other words, the cost of fuel to evaporate a given quantity of make-up feed water would be 12.3 times as much if delivered to the low-pressure receiver as when delivered directly to the feed water, and 16½ times when delivered to the condenser.

COMPOUND EVAPORATORS.

An arrangement for evaporating water that is widely used on shore where pure water is required, and is also gradually making its way on board ship, is what is practically a compound evaporator. There are two evaporators exactly alike. Live or exhaust steam is supplied to one evaporator, but the steam formed by evaporation from the sea water in the first apparatus is caused to circulate through the steam heating pipes of the second apparatus on its way to the hot well or to the condenser. The compound evaporator is applicable both to evaporation for feed make-up, or to distilling water for drinking purposes, and it will be seen must be a source of economy.

FRESH-WATER DISTILLING APPARATUS.

The supply of fresh water is one of the most important requirements on any ship, and it is met by an extension of the principle upon which the evaporator is constructed. The fresh-water distilling apparatus for the supply of drinking water consists of an evaporator, plus some simple form of condenser. The steam, in place of being taken to the feed water, or to the low-pressure cylinder, or the condenser, is taken through a condenser, of which there are various forms, all on the same principle. The steam usually passes through a coil of tubes, the outside of which is exposed to the action of cooling water.

THE AIR PUMP FOR CONDENSERS.

The air pump is one of the most important auxiliaries on board ship. The modern air pump used at sea is almost universally of the Edwards type, a section of which is shown in

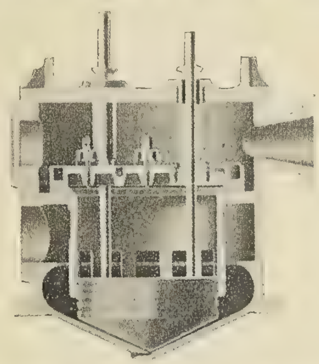


FIG. 3.—SECTION OF EDWARDS AIR PUMP.

Fig. 3. It will be remembered that one of the great difficulties in connection with the condenser is the removal of the air, which comes over with the steam from the exhaust. Water dissolves air, and any water which is employed for boiler purposes carries a certain quantity of dissolved air with it into the boiler. The dissolved air is driven off as the boiler gets under steam, this being one of the peculiar properties of gases and liquids. Water has the property of dissolving most gases, but its ability to hold them in solution decreases very rapidly as the temperature rises. Hence, as the water in the boiler rises in temperature, the air is driven off and is carried over with the steam into the cylinder, and thence to the condenser. Mr. Charles Parsons states that he has found the air coming over from the engine with the steam has a blanketing effect upon the particles of water. That is to say, the presence of a layer of air around a globule of steam prevents the extraction of heat from the steam necessary to its conversion into water.

The development of the air pump has taken place on two lines. In the early days of steamship propulsion, and right up to the present day, in a great many ships, the air pump was driven from the main engine. Modern practice is to drive independently by a separate engine.

The other development of the air pump has been in the construction. The old form was of the bucket type, and Messrs. Weir, who have done so much in steam engineering for ships, have developed the old bucket pump and claim to produce an equally good result with the valveless form. In the Weir pump, which is shown in Fig. 4, there are three

valves, a suction valve, a valve in the piston, and a delivery valve, and it is claimed by Messrs. Weir, as the writer understands, that the construction of these valves, which are of the Kinghorn type, enables them to produce at least as good a result as in the valveless form of pump. In the complete single, or monotype air pump, as shown in Fig. 4, the water chamber is formed by a cylindrical casting and supports the steam cylinder above by stay-rods. The twin type of air pump appears to be a great favorite.

The importance of the independent drive of the air pump can hardly be overestimated. Modern practice in engineering is to have independent control of every part of the apparatus. It means economy.

In the Edwards air pump, which is made by a large number of firms, the claim is the absence of foot and bucket valves. The great feature of the pump, as will be seen, is the conical shape of the piston and water chamber. In the Edwards

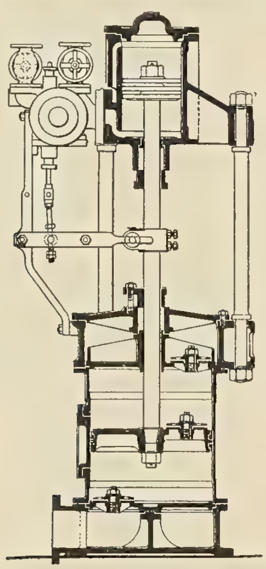


FIG. 4.—WEIR'S MONOTYPE AIR PUMP.

pump, the water formed by condensation of steam flows continuously by gravity from the center into the conical-shaped chamber forming the base of the pump. The water is forced upwards by the descent of the conical bucket, which is virtually a piston, and on the upward motion of the bucket it is forced through the valves at the top of the barrel. It is claimed for this pump that it is in no way dependent on the pressure in the condenser to drive the water into the pump, and consequently that an increase of speed in the pump does not impair its efficiency. The Wheeler Condenser & Engineering Company make the Wheeler Edwards air pumps in single, twin and triplex form.

CIRCULATING PUMPS.

The circulating pump has developed very much on the same lines as other pumps. The principal advance has been in details of manufacture. As marine engineers are aware, there has been practically a revolution in constructive methods in engineering during the past twenty-five years. Twenty-five and thirty years ago the average mechanic thought he had done very well indeed if he fitted to 1/16 inch, and was more than proud if he fitted to 1/32 inch. In these days fitting to 1/1000 inch is nearer the universal practice. Machine tools of all kinds have been developed, and it is only fair to say that America has led the way in their development. The American method of turning out a number of parts of any apparatus, all exactly to gage, and that a very close gage, now practically rules the world of engineering manufactures. It has led to very much better construction, very much better fitting, and to the possibility of using apparatus that could not be used before.

The ordinary plunger pump is still used for circulating water, but it is giving way to the centrifugal pump. The centrifugal pump has also been enormously improved during the last twenty years. Both forms of pump, however, are used.

ENGINES FOR DRIVING AUXILIARY MACHINERY.

Another very important development that has taken place in connection with marine auxiliaries is in the matter of the engines employed for driving them. In the early days single, open-type engines were almost universally employed. They were naturally wasteful in steam and troublesome to look after. Gradually the compound engine has displaced the single engine, and occasionally triple-expansion engines have been employed. Another and a more important development has been the use of the enclosed engine. It will be remembered that enclosure of the crankshaft enables very much higher speeds to be employed than in the open type engine, and this combined with the advances that have been made in the methods of lubrication of high-speed engines has led to their general employment for driving auxiliaries on board ship.

FEED-WATER HEATERS.

Another source of economy which is now almost universally employed, and that has gradually come into use, is the feed-water heater. There is not only an economy in delivering water to the boiler, at the temperature of the water already there, when it can be done at the expense of heat that would otherwise be wasted, but it also adds to the efficient working of the boiler itself, to avoid the entrance of bodies of water

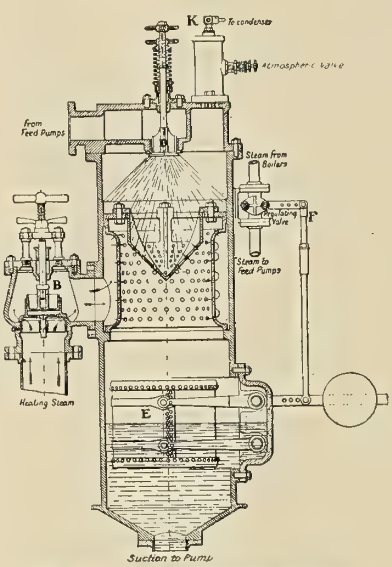


FIG. 5.—WEIR'S FEED-WATER HEATER.

at intervals at a lower temperature. As marine engineers know, for the efficient working of a boiler, the action must be continuous. There must be water continually being heated at the surfaces of the tubes and furnace crowns; this water must be continually passing upwards and giving place to other water to be heated in its turn and pass upwards, and so on. So long as the whole body of the water present is of nearly the same temperature, allowing for the difference in distance from the source of heat, this action should go on uninterruptedly. If, however, a cold douche is given to some part of the boiler circulating system, the circulation of the water must be interfered with, and the results must be inefficient working, more trouble to the engineer and fireman and increased consumption of coal. Hence have developed various kinds of apparatus for utilizing the heat of the exhaust steam.

There are a large number of feed-water heaters on the market, but with few exceptions they are constructed on very much the same lines. There is an outer containing vessel, usually cylindrical in form, with a vertical nest of tubes held between two plates fixed near the top and bottom of the containing vessel. The water passes through the tubes, the outside of the tubes being exposed to steam, which is allowed to pass over them on its way to the condenser. In some forms, however, the reverse arrangement is made. The steam passes through the tubes and the water circulates outside. The feed-water heater is sometimes included in the same containing vessel as the condenser. As mentioned above, the Wheeler Engineering Company make a combined feed-water heater and condenser, the steam to be condensed passing through the feed-water portion of the apparatus first, and then to the condensing portion. Other firms, the writer understands, have similar arrangements.

The direct-contact feed-water heaters of Messrs. G. & J. Weir are constructed upon different lines to those described above. As will be seen from Fig. 5, in the Weir apparatus there is an outer containing vessel and an inner perforated cylinder, into which a perforated cone projects from above. The annular space between the perforated cylinder and the containing vessel forms a steam space, and the steam being delivered to this space passes through the perforations in the inner cylinder, and there meets a stream of water coming down from above. As will be seen by the drawing, the water is forced into the upper portion of the containing vessel under pressure. It is sprayed out on entering the space above the perforated cylinders, and it is further broken up by the perforated cone, which is held inside the perforated cylinder. It is claimed by the makers that the breaking up of the water into spray and the mixing with the steam gives a high economical heating effect, the whole of the heat of the steam being delivered to the water. The lower portion of the containing vessel, as will be seen from Fig. 5, forms a receiver for the heated water. In this receiver is a float supported upon a lever and opposed by a balance weight. The outer portion of the lever controls a valve supplying steam to the feed pumps. The speed of the pumps is thus controlled in accordance with the quantity of feed water delivered to the heater.

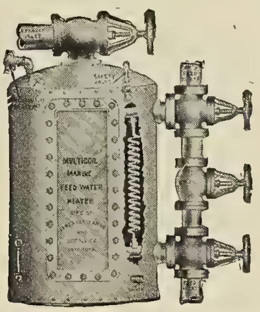


FIG. 6.—THE REILLY MULTICOIL FEED HEATER.

In addition to the above, attached to the upper portion of the apparatus, is a valve leading either to the atmosphere or to the condenser. It is claimed by the makers that as the pressure of steam in the heater is less than the pressure at which the water is delivered, the heating of the water and the lowering of the pressure liberates the air in the water, which passes off by way of the air valve mentioned, either to the atmosphere or to the condenser, the feed water being thus rendered non-corrosive.

The steam for the Weir feed-water heater is taken from the low-pressure receiver of the main engines and from the exhaust of the auxiliary engines.

The construction of the Reilly Multi-coil Feed-Water Heater, manufactured by the Griscom-Spencer Company, New York, as shown in Fig. 6, is similar to that of their evaporator previously described.

FEED-WATER FILTERS AND GREASE EXTRACTORS.

Another important auxiliary that has been found necessary, and that has led to further economy, is the feed-water filter and grease extractor. Experience has shown that a thin film of oil, on furnace crowns for instance, offers such a large resistance to the passage of heat through it that the plate is heated to a high temperature when the ship is under steam, leading to rapid wearing out. The same thing, of course, applies to boiler tubes, no matter what the form of the boiler may be, and to other surfaces, across which heat has to travel in the ordinary working of a boiler. As explained above, every gas has the property of absorbing the vapor of other substances. Steam behaves in this matter as a gas, and it absorbs a certain quantity of the vapor of the lubricant, carrying it over with it to the condenser, sometimes depositing upon the condenser tubes and leading to inefficiency there, and often being carried forward through the condenser to the hot well and back to the boiler. Practical marine engineers discovered a good many years ago that this was the cause of a good deal

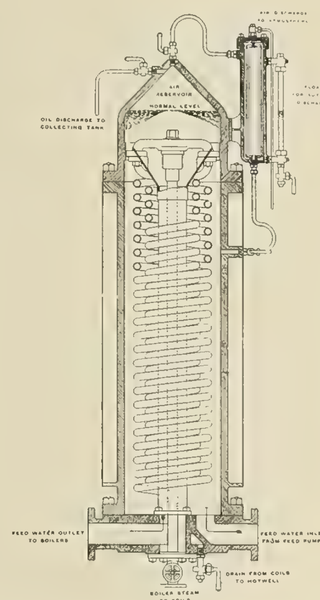


FIG. 7.—MORRISON FEED HEATER AND FILTER.

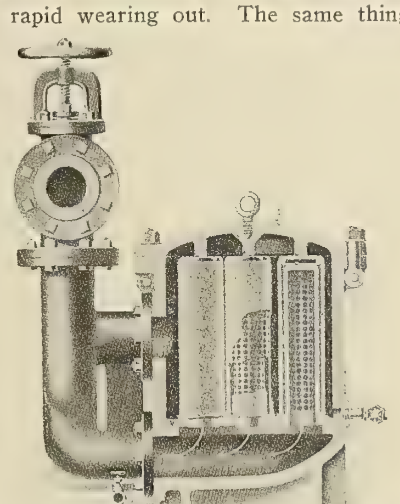


FIG. 8.—THE BLACKBURN-SMITH FEED-WATER FILTER.

of the deterioration of boilers at certain portions of the heating surface.

To meet this difficulty oil separators and oil filters have been introduced. The oil separator is very similar to the steam separator. As with other apparatus there are many forms on the market, all on very much the same lines; in all of them the steam is allowed to expand inside a chamber in such a manner that its velocity is very much decreased, and baffles or other arrangements are placed in the chamber in the path of the steam, the object being to arrest the globules of oil, and to cause them to drain down into a well provided for them. The oil separator and feed-water heater are sometimes united in one apparatus. In the Morrison feed-water heater, made by Messrs. Richardsons, Westgarth & Company, which is shown in Fig. 7, it is claimed that the air and oil are removed from the feed water in the process of heating. There is a central tube surrounded by a coil of steam pipe, heated by steam from the boiler or any convenient source. The feed water to be heated enters the annular space in which the steam coils are fixed, passes upwards to a conical chamber at the top, and thence down through the central tube to the bottom of the vessel and out to the boiler. It is claimed that the air and oil are carried upwards into the conical chamber at the top, the air being carried off to the atmosphere and the oil discharged periodically by a cock provided for it. The North Eastern Marine Engineering Company, of Sunderland, make a somewhat similar apparatus. There is central tube surrounded by a steam coil and a dome-shaped space above. The arrangement is, however, different from that in the Morrison apparatus. The feed water enters the central tube first, passes upwards, and then down through the annular space enclosing the steam coils and thence out to the boiler. The space above is employed to clear off the oil and water by means of the scum valve. The feed-water filter is a natural adjunct to the feed-water heater and oil separator. With even the most perfect separator it is not possible to ensure that the oil shall always be removed, and, as marine engineers know, a very fine film of oil upon the boiler tubes or furnace crowns will cause a good deal of trouble. It is now usual, therefore, to interpose a filter in the path of the feed water before delivering it to the boiler. Messrs. Willock, Reid & Company make such a filter, a sectional drawing of which is shown in Fig. 9. As will be seen from the drawing the feed water enters by the inlet provided for it. Its entrance into the filter is controlled by a valve, and it is made to pass through the filtering material and thence out to the boiler, the oil being absorbed by the filter on the way. A branch cock is provided for letting the oil and condensed water off from time to time, and the filter material can be changed when required by removing the door shown on the right. A by-pass is provided to enable the apparatus to be cut out if desired.

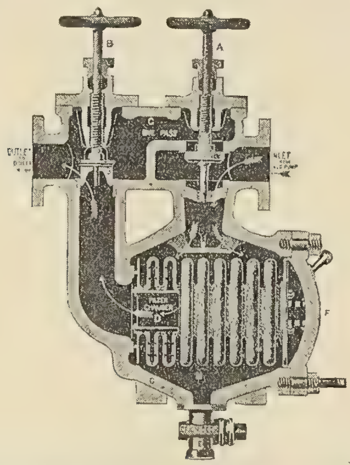


FIG. 9.—SECTIONAL VIEW OF THE WILLOCK-REID FILTER.

The Blackburn-Smith feed-water filter and grease extractor, shown in Fig. 8, is manufactured by James Beggs & Company, New York. It consists of a chamber containing a number of cartridges which compel double filtration through two separate and independent surfaces. Each cartridge consists of two concentric cylinders of heavy perforated brass tubing covered with linen Terry. The apparatus can be easily cleaned by removing the outer cartridges and replacing them by spare ones, suitably covered with the filtering material.

Other types of filters, as manufactured by the American Steam Gauge & Valve Company, Boston, and Alexander Miller & Company, Jersey City, are described elsewhere in this issue.

BOILER-FEED PUMPS.

The boiler-feed pump is also an important apparatus, and it has undergone a process of development, in common with other auxiliaries, to enable it to keep pace with other advances. The requirements for pumping water at 200 degrees F., for instance, are different from those of a pump for water at the ordinary temperature of 60 to 80 degrees. The usual arrangement now is, the pump is fixed vertically, with the pump barrel below, and a steam cylinder above, the steam cylinder being supported by rods fixed to the top of the pump barrel. The feed pumps are sometimes arranged in duplicate. The important points are: the proper construction of the pump barrel and bucket, and the construction and control of the entry valve to the steam cylinder. In Messrs. Weir's feed pumps, the pump barrel is made of close-grained cast iron, fitted with a gun-metal lining in the barrel, or entirely of gun metal as required. The pump bucket is made of gun metal fitted with ebonite packing rings. The valves and seats are made of special manganese bronze, working on a gun-metal seat. The piston and pump rods are of cold-rolled manganese bronze. The main valve admitting steam to the steam cylinder is an ordinary slide valve moving horizontally, but there is an auxiliary steam valve controlling the motion of the main steam valve and moving vertically on a flat face.

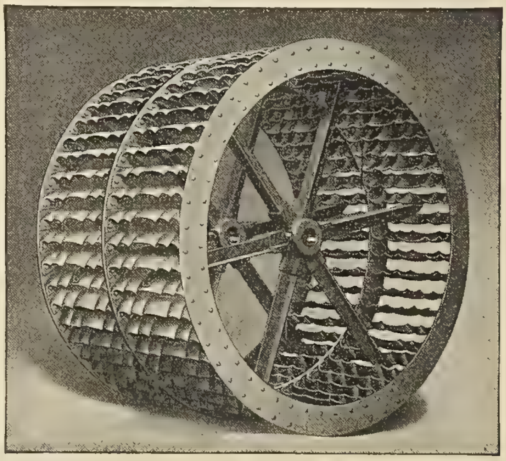


FIG. 10.—THE STURTEVANT MULTIVANE FAN FOR FORCED DRAFT.

DRAFT APPLIANCES.

Both forced draft and induced draft have been largely introduced for marine work. By forced draft is meant the delivery of air to the ash-pit under pressure, in place of relying upon the draft caused by the difference between the weight of the gases in the funnel and the corresponding column of air outside. By induced draft is meant the provision of a suction fan on the funnel side of the boiler drawing the hot

gases through the furnace, and causing a corresponding draft of air to follow through the ash-pit, grate bars, etc. It is found that by increasing the pressure at which the air is delivered to the fuel, larger quantities can be burnt upon a given grate area, and that the combustion of the fuel is carried on more economically. In addition, there is the important fact that either forced draft or induced draft renders

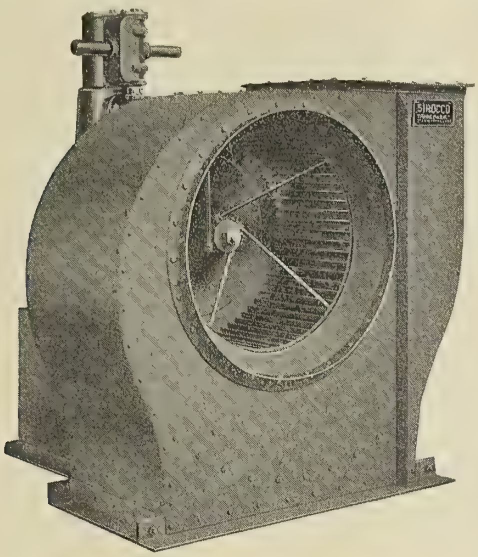


FIG. 11.—SIROCCO TOP VERTICAL DISCHARGE EXHAUST FAN FOR INDUCED FOR HIGH-PRESSURE FORCED DRAFT.

the boiler furnace practically independent of the funnel. The funnel need only be high enough and large enough to carry off the flue gases at such a height above the ship's deck that they will not be a nuisance to those on the deck.

With forced draft, either the stokehold must be closed in and the air delivered to it, or air pipes must be led from the

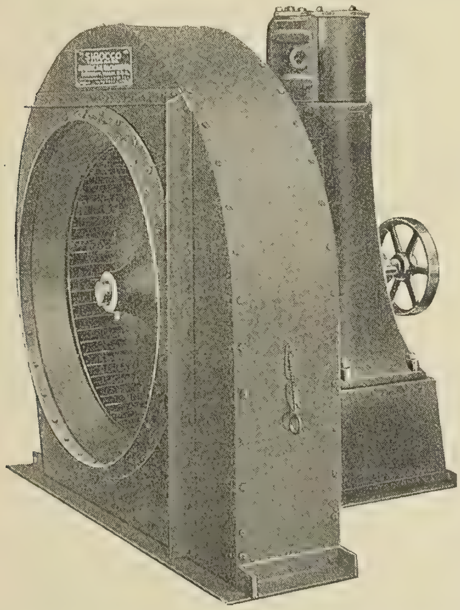


FIG. 12.—SIROCCO BOTTOM VERTICAL DISCHARGE FAN OF SPECIAL WIDTH DRAFT AND VENTILATION.

fan to the different ash-pits and the air delivered through them. Fans used for both induced and forced draft are of the centrifugal type. The propeller fan is of no use for work of this kind. The pressure required with both forced and induced draft may be as much as 2 inches water gage, or, in special cases, even more, and the propeller fan is only able to produce a pressure of a small fraction of an inch of water gage. Almost any form of centrifugal fan will answer both for forced and induced draft, but fans employed for induced draft must be wider than those for forced draft to accommodate the larger volume of gas at the higher temperature, and in addition they must be arranged as far as possible to withstand the action of the flue gases.

Heating the air for the furnaces has also been introduced by Messrs. John Brown & Co., of Sheffield, the air being caused to pass through a nest of pipes on its way to the ash-pit, the pipes being exposed to the heat of a certain portion of the flue gases. Among those making fans for induced and forced draft may be mentioned Messrs. Davidson & Co., of Belfast, Messrs. Drysdale & Co., of Glasgow, and others.

AUXILIARIES FOR OTHER PURPOSES.

In addition to the auxiliaries described above, which form part of the main steam propelling plant, the development of the passenger service and the increased size of ships has demanded other auxiliaries. Electricity is now largely employed on board ship, both for lighting and power, and among the most important steam auxiliaries are the engines driving the dynamos. Cold storage is also an important adjunct to the equipment of every passenger steamer of note, and of every man-of-war above a certain size, and again among the important auxiliaries are the engines or motors for driving the cold-storage compression plant. The modern passenger steamship also is very much like a hotel. Baths and lavatories form an important part of its equipment, and this again demands a supply of hot and cold water, the pumps for which are again among the important auxiliaries. The fire pumps, again, the bilge pumps, and others, are also necessarily larger and more powerful than in past times.

The question of the ventilation of the ship has also forced itself upon designers and engineers, and an important part of the auxiliary machinery is employed in this work. All these, however, have been described in previous articles by the present writer.

The New York Motor Boat Show.

The Sixth Annual National Motor Boat Show was held at Madison Square Garden, New York City, Feb. 19 to 26, under the auspices of the National Association of Engine and Boat Manufacturers. Greater interest than ever before was manifested in the show this year, and both the attendance and the amount of business transacted was far ahead of anything which has been done in previous years. The exhibits were exceptionally good, and covered the whole range of motor boats, from the smallest power dory up to 40-foot cruisers, as well as engines of all sizes up to 300 horsepower. From the orders placed it is evident that the motor boat propelled by an internal-combustion engine is fast displacing the expensive steam yacht. This is a natural development, since the motor boat gives practically the same accommodations with a smaller and less costly hull than a steam yacht, and the expenses of operating the boat are also less, since the crew is reduced to a minimum and the up-keep of the machinery is not so expensive. There still seems to be little activity, except in an experimental way, with other fuels than gasoline (petrol) for motor boats. Crude oil engines and producer gas are not yet being adopted to any great extent, but the increasing use of motor boats for commercial purposes and the increasing size of installations indicate that the cheaper fuels will soon be in demand, and as soon as such a demand is felt the development of engines to use these fuels will be rapid.

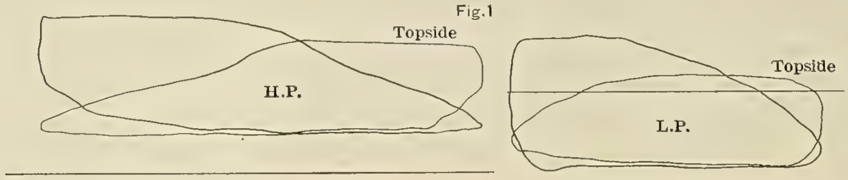
PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Defective Indicator Diagrams.

By the workmen the indicator gear of a steam engine is often regarded as a superfluous part. They frequently consider that it has nothing to do with the success of the running of the engine, as it is generally removed after the trial trip. So the foremen must give special care to the steam passages to the indicator cocks, seeing that these are clear and cleaned from core sand, by means of which the piston often grips in the indicator cylinder. More depends upon the indicator gear than most workmen realize, as on a coal trial the quantity of fuel burnt per horsepower per hour will be too much, when the indicator diagrams indicate less horsepower than is exerted on the pistons of the engines.

Fig.1



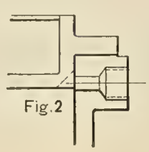


Fig.2

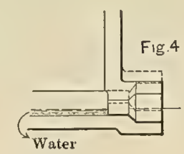
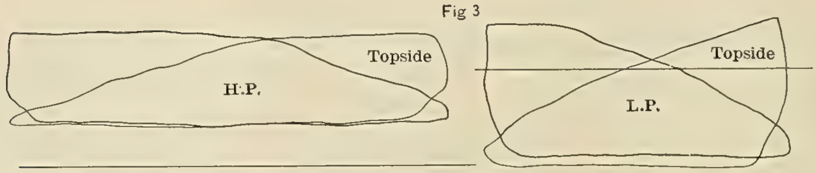


Fig.4

Fig 3



The first high-pressure and low-pressure diagrams of the triple expansion engine of the tug *M. H.* are given in Fig. 1. It is seen that the pressure on the top sides of both pistons is less than on the bottom sides. It was thought that something was wrong with the steam distribution, but the first thing to be examined was the steam passages to the indicator cocks. It was found that the cylinder cover partly covered the holes in the cylinders (Fig. 2.) The covers were altered, as shown by the dotted lines, and then another set of diagrams was taken. These are shown in Fig. 3, and it will be seen that they are so much better that an alteration of the steam distribution is unnecessary.

On the bottom sides of the low-pressure cylinders the steam passages are often restricted by the condensation water (Fig. 4), therefore it is recommended to have the holes as high as possible, as indicated by the dotted lines. D. K.

Lubrication.

Although as much attention should be given by the engineer of a boat to lubricants as to boilers or engines, he is somewhat handicapped in this respect, inasmuch as he has no proof of the quality of the lubricants sent on board. They may appear to be of the best value, and yet be composed of very poor oils or greases. The fact of dealing with reliable firms always, or almost always, removes the necessity for experience in testing oil, but a simple method which could be applied under all circumstances, and in all ports would be of great advantage to the engineer, especially in the case of vessels trading abroad, and having to obtain supplies at any available port.

The truth of this contention may be evidenced by the recital of a series of troubles which occurred on a boat which, unfortunately, ran out of the home supply and had to replenish by a stock of oil from foreign sources. The oil ordered for the use of the engines was of a well known make, with a big reputation, but succeeding events showed that either the oil had been adulterated or tampered with, inasmuch as it was almost useless as a lubricant. The first evidence of trouble was that the engines began to heat up mysteriously in the middle of a long voyage, the crank shafts became hot, the connecting rod top ends subsequently followed suit, and then the guides joined the participants in the trouble. It soon proved to be no ordinary heating up which had set in. Extra care and nursing were resorted to. Previous to this trouble the engines had been run for years without water in the bearings, but it soon became necessary to turn on the water to the bearings. Finally a stop was made and an examination carried out of the bottom ends. These appeared to be in good order and did not show any broken pieces of white metal, or anything which would account for the heating. They were therefore replaced and adjusted to take up the wear and tear, and a fresh start was made. The heating of the bearings still went on, and everybody was at a loss to account for the trouble. Oil was used in large quantities, and a very careful system of nursing was resorted to. It was, however, of no use, and this trouble had its natural effect on the engines, further wear and tear being experienced. Another stop had soon to be made and the bearings were again taken to pieces and examined, adjustment and replacement followed, and the engines were restarted.

* We pay for these articles.

This series of heating and stopping went on for some days and did the engines a good deal of harm. During this time everybody was on the alert to try and leave the engines cooler than they were at the beginning of the watch. Incidentally a good deal of ill-feeling was caused by the trouble, and each engineer was suspicious of the others, and blame was attached to each and all in turn. This did not mend matters, and a further stop had soon to be made. The top and bottom brasses were taken down and rebedded and adjusted. Attention was also given to the guides and eccentric straps, which were the last to start and give trouble. This occupied 16 or 18 hours, and everybody was worn out by the fight.

After a start was made again, the oil was mixed with a small proportion of cylinder lubricating oil. The effect of this was almost instantaneous. In a few hours the engine was running as it formerly used to do, and the trouble disappeared, the only care necessary being to watch the bearings very closely and oil them frequently to bring the surface up to perfection again.

The only explanation which could be advanced for the fact that the oil was of no use was, that it had decomposed with the heat of the engine room and required some attention to make it retain its lubricating properties in a high tropical temperature. Cylinder oil is, of course, specially designed for high temperatures and therefore answered well, but the fact remains, however, that the oil supplied should have been good enough for any climate, and it was impossible to tell that it was a poor oil by its appearance. All the usual tests were satisfactory; it lathered when mixed with water and stirred, it had a golden color when viewed running from a spout, and a bluish tint when standing in a vessel. It was not too viscous and not too thin. It would therefore be interesting to have a good reliable test for lubricating oil which a marine engineer could apply on board ship before making the test on his engines.

If, however, the writer should be so unfortunate as to have a similar experience in future, he will, after satisfying himself that the heating is due to bad oil, mix it with good cylinder or castor oil according to the supplies at hand. The proportion used in the above case of cylinder oil or ordinary oil was about one-third. Cylinder oil is, of course, far too thick to be used by itself, and there is often a lack of it, as perhaps only five or ten gallons are kept on board at one time. If, however, the question of economy is studied, it will be seen that it is best to use even cylinder oil to improve the lubricating properties of ordinary oil, as during the time the above trouble was in progress three times the quantity of oil allowed for the engines was used. This was not due to any more or less automatic pipes or syphons or other labor-saving devices, as the oiling in this ship was always done by the engineers by hand.

T. S. MARTIN.

Cementing a Broken Steam Pipe.

New uses for cement are being found every day on board ship, one of which the following experience with a broken steam pipe illustrates. Several years ago less precaution was taken in the manufacture of steam pipes than is taken to-day, especially as regards the uniformity and tensile strength of the metal in the pipe, and consequently fractures were not uncommon.

Such an accident happened aboard one of the L. & H. liners bound for the west coast of South America. The pipe in question was the forward hoister line, which extended up through the fiddley and laid uncovered and exposed its entire length on deck to the different hoisters. This detrimental feature, of course, necessitated the closest watch when using the line in cold climates to insure that the pipe did not collect water at certain times unawares. However, the deck crew was using the hoisters in rigging the derricks when nearing Punta Arenas, in the Strait of Magellan, in the month of July, which is noted as a very cold month at that port. Apparently there were no immediate signs of danger with the hoister line, but nevertheless the pipe burst at a supposedly strong place. The fracture was in a bend, but away from all faulty positions.

This necessitated the shutting down of all the forward engines, and repairs were started in the usual manner. The crack extended in a lengthwise direction about 10 inches, then partly circumferential for about 3 inches. In repairing, several suggestions were given, and the quickest for a trial was to wrap some high-pressure sheet packing around the pipe, then wind this closely and tightly with heaving line. To our regret this lasted less than an hour when it blew out the sheet packing, consequently a more durable method had to be employed, and here is where the cement played the important part.

New sheet packing was wrapped around the pipe again, and securely bound with wire wound very close together, then a wooden box was made about 20 inches long, and allowing about 2 inches clearance all around the pipe. See Figs. 1, 2 and 3. The box was nailed together around the pipe, with the

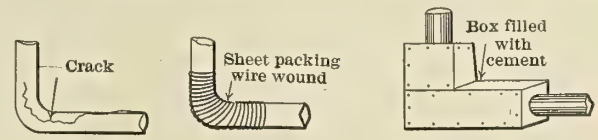


Fig.1 Fig.2 Fig.3

top open. In this the usual mixture of cement was poured until the box was completely filled. The steam valve was "cracked," admitting only enough steam to keep the pipe hot, which hastened the drying of the cement. The cover of the box was left off for a few hours, as the cement would shrink in bulk when drying, and some more had to be added in due time in order to fill the box, which, of course, was done. The lid was then nailed on and results anxiously awaited.

By the next day at about 8 P. M. Punta Arenas was reached, and our cement repairs, which had been thoroughly dried by that time, were given a test. The line was handled very gingerly at first. However, this was soon overcome and in about one hour the pipe had full load upon it and continued so for several days, never once showing signs of weakness or leakage. "Let well enough alone" was the motto then, and on the return voyage a few months later, when again in the cold climate it was still tight.

The ship stopped at Buenos Ayres, Pernambuco, Newport News and New York before a shop job was made of the pipe. On removal of the cement the sheet packing was still intact, and it was so solid that the engineer stated that it would have held out at least a year more before they would expect any weakening.

Referring again to the material of which the pipe was made, in those days a decidedly poor grade of iron was used. Most modern ships do not use iron pipe where it must be exposed to the elements. Copper is used instead, therefore an accident of like nature is much rarer now than then. Nevertheless, the material and principle used in connection with this repair would no doubt serve admirably in several other localities where steam pipes are confined.

F. J. W.

The steamer *Answald,* recently built by the Bremer Vulcan at Vegersack for the Hamburg-Bremen Africa Line, is said to be the first German ocean steamship to be fitted with a superheater. The *Answald* is a boat of 7,800 tons, with a designed speed of 12 knots. Schmidt superheaters are fitted. On her trial trip the engines indicated 3,650 horsepower, giving a speed of 13.5 knots.

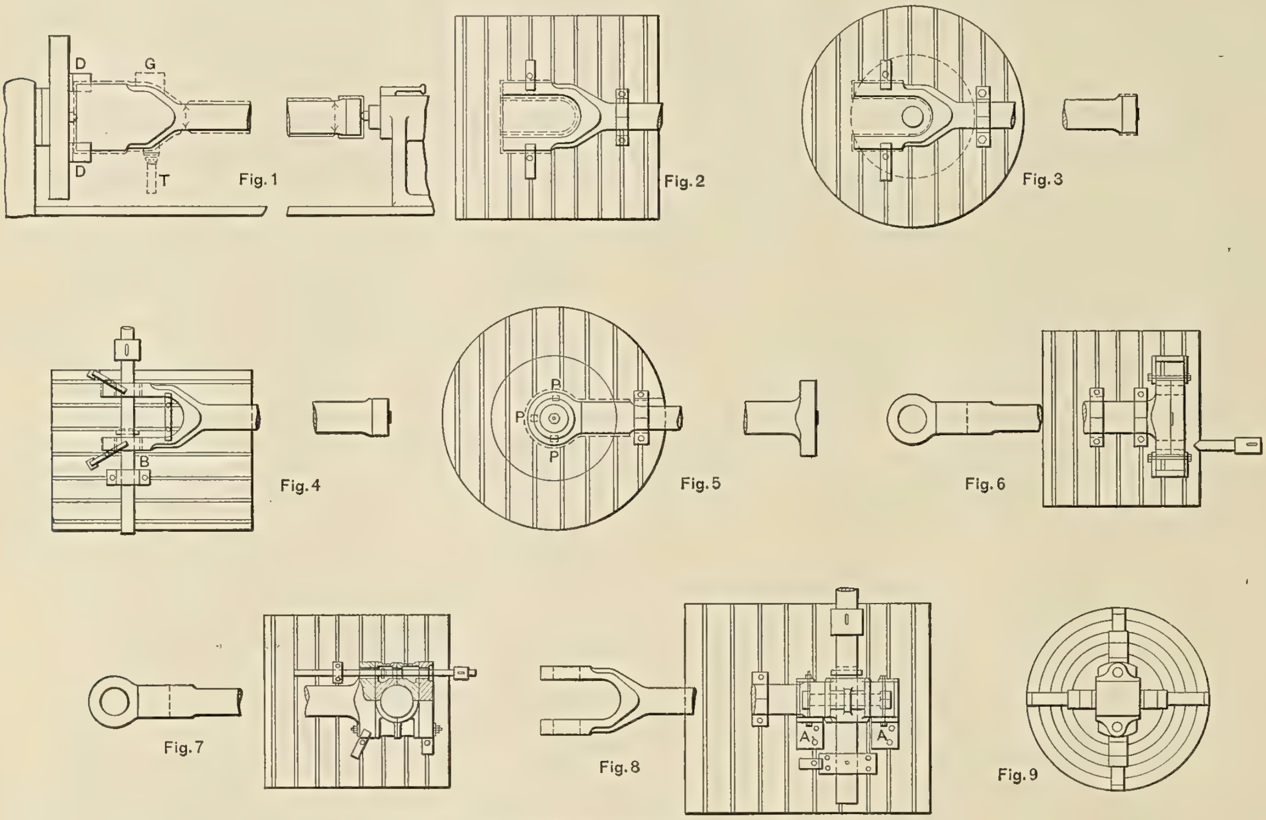
Machining a Connecting Rod.

The first operation is to test the rod on a surface table to see if the forging will machine to drawing sizes, and at the same time to locate the centers of the rod for turning. When the rod is set up on the table in the position shown in Fig. 1, the average center line of the forging is found by measurement and a line drawn on each end. After this, the rod is rotated one quarter turn, and, after squaring up and finding the average center, lines are drawn on the ends of the rod crossing the other lines at right angles; the intersection of the two lines is the center on which the rod will be turned. A light punch mark is made at this point, and two concentric circles are drawn on each end and dabbed in; these are to serve as a guide to the turner when centering and drilling his centers.

The procedure in centering is to form centers deep enough to support the weight of the rod by means of a heavy turner's center punch; the rod is then placed in the lathe, as shown in Fig. 1. To ascertain how the metal will average up, the machinist often rotates the rod at this stage; as, should any discrepancy appear, the centers can easily be shifted, as they are not very deep, whereas it would be a much more serious operation to shift the centers after they had been drilled in full size.

The centers are often drilled in the lathe, the rod being supported on suitable packing. When mounted, as shown in Fig. 1, the turning operations can be completed without removing the rod from the centers. Two heavy angle-plate drivers *DD* are attached to the face plate; a stopper is sometimes fixed to prevent the rod springing away from the drivers when machining the butt and head of the rod; thus preventing the jamming of the lathe and gearing, which would otherwise occur.

The butt is first roughed up to within about 1/32 inch of finish size, the fillet also being roughed down to this size. The parallel part of the head is now roughed down to within 1/32 inch of finish size, the fillet also being roughed down. A cut is now taken over the sloping portion to remove some of the surplus metal, and the fillet on the rod roughed to within 1/32 inch of size. The lathe rest is now moved round to the correct angle for turning the sloping part of the head, and, working from the body of the rod, it is roughed down and scraped; the fillet on the rod may also be finished at this time. After moving back the slide rest, the parallel part of the head is scraped to size. Rounding off the sharp corner on the head to the correct radius is the next step; a gage *G* being used, located in the proper position relative to the parallel and tapered parts. A formed spring-tool T is used to produce a smooth finish.



VARIOUS OPERATIONS IN MACHINING A CONNECTING ROD.

Finishing the foot of the rod is the next step. The tailstock of the lathe is now set over to allow the body to be turned to the proper taper; this finishes the turning operations on the rod. As will be seen from the sketch, the head of the rod is a solid forging. The rod is now taken to the surface table and lined off for machining the sides of the jaws and the feet of the rod; the jaws are also lined off for machining out the metal between them.

Sawing out the metal is the next step. This operation is shown in Fig. 2, where the rod is shown bolted on to the table of a bandsaw. Enough metal is left to allow the jaws to be finished to size in a slotting machine. The rod is now placed on the slotting machine, Fig. 3, and the inside and bottom of the fork machined to size. The outside faces are also machined at this setting. Machining the sides of the rod foot may also be done on the slotting machine.

Boring out the jaws for the crosshead pin is the next step. In Fig. 4 the rod is shown on the table of the horizontal boring machine. The holes are first roughed out as much as possible with drills, then a long cutter bar is passed through both holes, being supported by the bearing *B*. The remainder of the metal is roughed out and the hole finished to size with this bar.

To slot the edges of the jaws the rod is mounted on the slotting machine table, Fig. 5. To locate the hole central with the table a turned disk is used, having a projection on the underside, which fits into the hole in the center of the table, and also one on top fitting the hole in the rod. A heavy stud is sometimes fitted into this disk, and serves to clamp the rod in place, packing pieces, *P*, being fitted between the jaws to prevent springing.

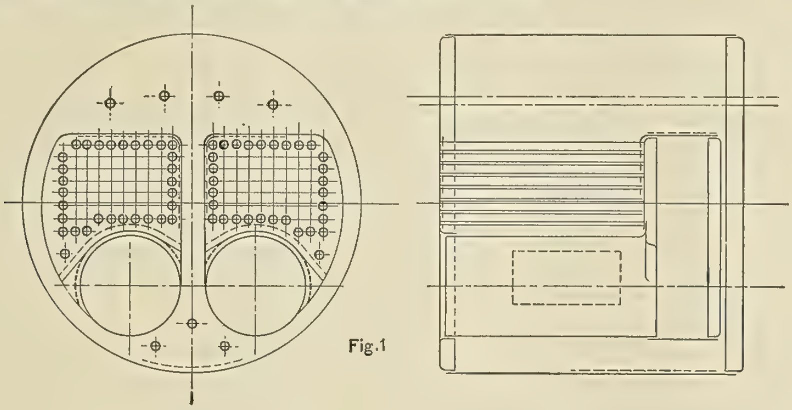
Facing the bottom end bushes and cover may be done very conveniently in the lathe, or boring mill, especially as a recess has to be formed on the top of the upper brass to fit the projection on the rod. In Fig. 9 one of the bushes is shown fixed in the chuck for machining the joint face. The edges of the cover may be either planed or milled, and if a suitable machine is available, both edges may be machined at the same time. Also, instead of slotting the outside of the jaws and the foot of the rod, if a suitable face mill of the planer type, with a cutting head on each upright, is available it should be used, as the outside of each jaw and both sides of the foot may be machined at the same time; or the inside of the jaws may also be milled if there is a machine to take in the rod and a sufficiently long cutter. As the circular part at the bottom of the fork is only for clearance, it will answer equally well if it is touched up lightly with the cutter, and need not be a true half circle. If this is done, the outside of the jaws and feet may be machined at one setting.

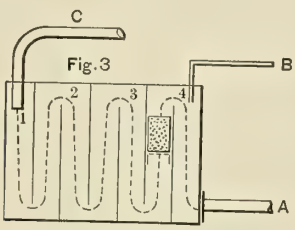
The next step is to bore out the bolt holes in the cover and foot of the connecting rod; they should not be bored out full size, a little metal being left for a cut and a scrape. This operation is shown in Fig. 6, the cover being clamped in position against the rod and the holes bored through both; the holes having been previously marked off on the cover. After this operation the bushes are set up exactly in position and held in place by means of a temporary bolt passing through one of the holes, and by suitable clamps on the other side. The bolt holes in the brasses are usually coned out. A cutter bar is now placed in position and the holes bored out to size. Fig. 7 shows this operation. The cover is also recessed for the nuts, and the foot of the rod faced up for the heads of the bolts at this stage.

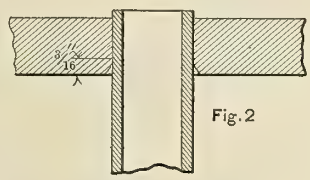
The next operation is turning the nuts and bolts. The nuts are bored and threaded to gage, then the bolts which have previously been turned to fit the holes are threaded and finished. They are then fitted into place and the bush is ready to be bored out for the crank pin; a circle first being lined off for the correct position.

In Fig. 8 the rod is shown fixed in position on the table, with the cutter bar in place; the rod being clamped against two angle plates *AA*. It is bored out and faced up to size. The crosshead pin may now be turned. A square is sometimes forged on one end in order that the pin may be turned without reversing on the lathe centers. It is turned a shrink fit for the holes. The lubricator holes may also be drilled at this stage, as, should the drills chance to break, they can be much more easily removed. The holes for the pinching pins in the covers may also be drilled and tapped. The holes for the crosshead pin may be heated by suitable Bunsen burners and the pin shrunk in. Boring and tapping the hole for the small locking pin, then fitting it in, finishes the machine work on the rod.

MACHINIST.







A PROBLEM IN OVERCOMING PITTING.

Pitting of Boilers.

In a former issue something has been said about boiler corrosion and its causes. The writer wishes to call attention again to the fact that the pitting of a boiler is one of the most troublesome mishaps an engineer may meet, as it generally will not stop entirely, even after all remedies have been tried.

The main causes of pitting are: air, sea water, oil and grease, pumped into the boiler with the feed water, and galvanic action. Sometimes rather strong acids are found in the boiling water. In one case known to the writer, the boiler water was taken in near a chemical factory, where strong waste acids were discharged into the river.

As a general rule the feed pumps of marine engines are much too large for their work, and it is a common rule to have the volume of the pump from two to three times the quantity of the condensed steam. But if the pump is too large, with every stroke a large quantity of air will be pumped into the boiler and the oxygen of this may attack the boiler plates. Where Weir's pumps are in use in connection with a Weir feed heater, it is not possible that any air may be discharged into the boiler by them, as the pumps stop if there is no feed water in the feed heater. But often boilers are found which show no pitting at all, even after several years' running, and without any means provided to keep the air out of the feed water.

The oil, which is used for lubrication of the cylinders, slide valve, piston rods and valve spindles, also finds its way into the boiler with the feed water, and with the high steam pressures and temperatures at which modern marine engines are worked, the oil is split up in the boiler and thereby fatty acids are formed, which may do much harm to the boiler plates. Therefore it is necessary to give to the engines and the rods as little oil as possible.

Sea water contains acids by which pitting may be caused, But with a new, clean boiler, it is strongly advised to feed salt water into the boiler during a short time to get a thin coating of scale on the inside of the plates, as this acts as a protection from the influence of the oxygen and acids which the boiler water may contain. The writer knows a large transatlantic tug company which always fills its new boilers with fresh water, and then keeps the boat moored for 24 hours, the engine running half speed, and the boiler using sea water for feeding. Thus the thin coating is formed, so that there is no danger of pitting, nor of the bulging of the flat plates and the crowns of the furnace. Especially is this danger prevalent in new boilers, as on the trial trips plenty of oil is always given to the engine, which subsequently may lodge on a plate in the boiler, so that it is overheated there and may bulge.

Galvanic action may also often cause pitting, and the only means to counteract its action is to place zinc slabs in the boiler. Such an action is only possible when the boiler water is an acid solution. Steel, with zinc in an acid, becomes electro-negative; the zinc, positive. At the zinc pole oxygen is liberated, which oxides the zinc. At the steel pole, hydrogen is liberated, which, with the oxygen dissolved in the water, forms water again. The zinc thus attracts the oxygen from the boiler plates, but the zinc and steel must be in perfect metallic contact.

A further cause of pitting is formed by the very small copper particles which are taken up in the feed water and pumped with it into the boiler. These particles come from the internal feed and scum pipes, the condenser tubes, the pump lines and the feed-pump valves, and from the copper, salts are formed in the boiler, which may attack the plates. Therefore it is recommended never to use copper internal pipes. Mr. Y. MacFarlane Gray (N. A. 1861, Vol. ii., p. 157) has detected copper specks at the bottom of pit holes, and attributed pitting to that cause. The condenser tubes are usually tinned outside, so that no copper particles can be taken from them by the feed water. But the tin particles may now be carried over to the boiler by the water, and it is believed that the corroding influence of these is even stronger than that of the copper particles.

The boiler of the government coast steamer *S* showed pitting after one and a half years' service. It was thought by the engineer that perhaps too much salt water had been supplied, and therefore more care was taken to fill the tanks up entirely with fresh water, which was taken in on a river at some distance in the country. But after six months the boiler was opened again, and the pitting showed itself such that some means had to be supplied. In Fig. 1 the dotted lines show where the pitting occurred, viz., on the top plates of the fireboxes; on the bottom of the shell, and on the tube plates where the iron tubes were expanded in them. Also around the fusible plugs on the top plates the corrosion was very severe. How the tube plates corroded is indicated in Fig. 2. Nearly around all tubes along the inside of the tube nests corrosion took place, but within the nests no corrosion at all could be detected. Along the path of circulation it seems to be most severe.

The boiler makers were asked how to stop the pitting, and they recommended first, to keep oil and air out of the boiler as much as possible. Therefore a tank was made as indicated in Fig. 3. *C* is a pipe from the hot well, and the condensed steam at the engine is pumped by the air pump into the tank. Therein the water is led up and down, the oil in the meantime being mostly separated from the water. In compartment 4 a case with fine coke was placed, with a perforated bottom. Much oil was found floating on the water in compartment 1; less in compartments 2 and 3, and in compartment 4 scarcely any oil was visible. *A* is the feed-pump suction, thus much oil, which was formerly pumped into the boiler, was now left in the feed tank. In the delivery-valve case of the feed pump a cock was placed, and a pipe *B* led from this eock to compartment 4 of the tank. When feeding, this cock was opened, thus a part of the feed water pumped back to the tank, so that the bottom of this was always covered with water, and no air could be taken in by the feed pumps. By regulating this cock, compartment 4 of the tank could be kept half filled.

So most of the oil and the air were kept out of the boiler. The pit holes were filled up with common Portland cement, as corroded places are most sensible. After two months the boiler was inspected again, but the oil and air apparently were not the causes, for the pitting was still rather dangerous, and it was evident that a new boiler would be necessary, unless the pitting could be stopped. The furnaces were also pitted on both sides, as indicated in Fig. 1. The cement in the pit holes did not hold, and was all washed away. It was then thought advisable to use more soda than the engineer had applied till that time, also to supply a little salt water for boiler feeding. The pit holes were now filled with a mixture of crown tar and red lead.

As the engineer had strong objections against the use of salt water, he tried the former means. After two months the boiler was opened and the interior found in good condition. The boiler plates were all covered with a very thin coating; the pit holes were still covered with the mixture, and no black strips indicating the pitting places could be detected. The boiler was therefore saved, and it was expected that a large quantity of soda would be taken on board. But this was not done, for the chief of the service for which the boat had been built could not believe that the use of the cheap soda would be a sure cure against the costly pitting. He thought a box containing a certain boiler compound worth $12.00 (£2/10) would do much better. So the boiler was treated with the compound. But after another two months the boiler again showed the dangerous pitting. The mixture in the pit holes had protected them against further pitting, but very many new holes had been formed.

Perhaps the manner in which the compound had been applied was not correct, but in this boiler, with this engineer, it could not protect the boiler plates. The boiler has been in use a long time now, using a generous supply of soda, and the pitting has stopped entirely. D. K.

How to Measure the Pitch of a Propeller.

Many people have often wished that the pitch of a propeller could be measured directly without interpolation of any kind. As a matter of fact, this can be done, and easily. It is self-evident that where the blade forms a pitch angle of 45 degrees, the circumference is equal to the pitch, because the distance around the circle is equal to the advance. Therefore, if a 45-degree triangle be placed on the blade at right angles, and moved along until the edge perpendicular to the shaft is parallel to the face of the hub, as can be seen by sighting over the triangle at the hub, the point where the triangle rests on the blade will be the radius of the circumference that is equal to the pitch. Therefore, if the pitch is wanted in inches, take a scale long enough for the largest radius wanted, say 60 inches, and multiply the 60 first by 2 for diameter, then by 3.1416 for circumference. The result is 376.992. Divide the

60-inch scale rod into 376.992, or, say, 374 equal parts. Each part will be roughly 1/6 of an inch. Now, place the triangle by sighting across the hub, and sliding the triangle until its side is parallel with the hub. Measure the radius to the triangle with the scale, and the result is the pitch directly.

Another way is to measure the radius with an ordinary rule, and multiply the result by 6.141, which is the pitch. Of course this method only gives the average pitch, and other methods must be used when the pitch of all parts of the blades are wanted; but where the blades are of commercially uniform pitch, this is a very accurate method of measuring them.

All modern wheels of any efficiency have a point where the angle is 45 degrees. The best authorities call for it to be near the center of effort, but it is to be found on all parts of the blades. On blades with high revolutions and slow speed, it is near the hub, or may even disappear at the hub. On blades with low revolutions and high speed (a very rare condition) it is near the tip.

E. N. Percy.

A Sudden Stop at Sea.

As the editor appears to be getting the practical men among his readers to come forward and relate their seagoing experiences, the following anecdote may be of sufficient interest to be classed among the list of breakdowns:

At 3 o'clock in the morning the chief engineer of a boat that need not necessarily be named came down in a hurry and routed out his staff second. On tumbling out he found, to his surprise, that the engines had stopped, and he could hear the boilers blowing off. There was evidently something wrong, and the two engineers raced down to the engine room together. The third engineer, who was on watch, was in a state of surprise. He said that the engines had suddenly pulled up, and he could not account for it. After they had stopped he had shut the steam off at the engine stop valve pending further investigation.

With a habit born of experience the second went to see for himself that the stop valve was properly shut, and to do so eased it, or opened it a little to shut it again. On easing the valve the engine, to the surprise of everybody, started to go a little. The chief gave orders to keep her going very slowly while he went up to the cylinder top to see if he could detect any unusual noises in the high-pressure slide-valve chest. This was the part of the engine that was, first of all, suspected by everybody. The chief had, however, hardly reached the top platform before the second felt a sharp knock on the stop-valve handle, and it at once dawned on him what the trouble was. The valve closed upwards, and evidently the valve seat had become loose. When the valve was open the seat had suddenly come down onto the valve and had chopped off the supply of steam to the engines, shutting them down.

The steam was then shut off from the boilers, and the faulty stop-valve chest opened. As was anticipated, the seat was loose, and it was taken out to repair the fault. This was done by wrapping it round and round with very fine copper wire. This had the effect of increasing the diameter of the part of the valve seat which fitted into the valve-seat chamber. When this was done, the wire binding was smeared over with manganesite plaster, and over this coarse emery powder was sprinkled. The valve seat was then put into place and driven hard up into position, and then the remaining parts were assembled. It was then possible to start the engines away, and after this experience the valve never gave any more trouble.

It is probable that the primary cause of the loosening of the valve seat was the rattling of the wings of the valve against the sides of the valve seat. In order to guard against trouble of this nature the valve seat would have been more secure if it had been fixed in position by means of small tap bolts. The incident is, however, sufficiently interesting, perhaps, to merit the attention of other marine engineers.

Joe Brown.

Two Sea-Going Repair Hints.

Sea-going engineers are often called upon to effect running repairs, which their friends on land would consider almost impossible, considering the very limited range of tools and equipment available on board ship. Many of the repairs thus effected can only be regarded as make-shift devices adopted to hold the trouble in its place until the ship reaches a port where more adequate facilities are at hand. At the same time it is perhaps to the credit of the marine engineer that he is in so many cases able to avoid immediate trouble by the exercise of a little ingenuity.

For example, one of the troubles to which a marine engineer is subject is the occurrence of leakage in his condenser tubes. This is first detected by the rapid filling of the boilers, or by observations of the density of the water in the boilers. If the density increases above its average, then it is easy to believe that there is a leakage of salt water from the condenser to the hot well, and this must be attended to as quickly as possible.

In order to find the leak it is necessary to take off the condenser doors and the manhole door, and fill the condenser full of water. By examination it can be readily seen which tubes are leaking, as the water will be observed running out of them. When they are found, wooden blocks should be made to fit the tube and driven in at both ends of the tube so that they are a tight fit, thus isolating that section from further action. This, of course, brings down the efficiency of the condenser until the ship is brought back to port, but it saves further trouble with the boilers, and the device answers very well for a temporary repair.

Another instance may be cited in the case of a fracture of an eccentric strap. This cracked right across, and of course threw the whole of the engine out of smooth running. It was necessary to shut down as quickly as possible, and to straighten the eccentric rod. In order to patch up the strap sufficiently well to carry the boat through to the end of her voyage, a piece of bar iron about 3/8 inch thick and 2½ inches broad was shaped to the outline of the top half of the strap. It was then bolted in its place by two bolts. On top it was held down by the weight of the eccentric rod. This repair bound together the two pieces which were cracked until the end of the voyage and prevented further trouble.

Edward S. Reid.

Full Speed Trial of Brazilian Destroyer.

The official full-speed trial of the torpedo boat destroyer *Santa Catharina*, built for the Brazilian government by Messrs. Yarrow & Co., Ltd., of Glasgow, took place Feb. 2 on the Skelmorlie deep-water measured mile at the mouth of the Clyde. During a continuous run of 3 hours, carrying a load of 100 tons, the boat exceeded her contract speed of 27 knots.

The *Santa Catharina* is the eighth of the ten destroyers ordered by the Brazilian government from Messrs. Yarrow. The first six vessels are now in commission in Brazil. The seventh will be leaving Glasgow shortly, and the ninth and tenth vessels are ready for launching. In these destroyers strength of construction and good seagoing qualities were deemed—as in the British navy—of even greater importance than high speed, as both the British and Brazilian destroyers have a guaranteed speed of 27 knots.

The dimensions of the Brazilian destroyers are: Length, 240 feet; beam, 23 feet 6 inches. They are propelled by two sets of four-cylinder reciprocating engines of 8,000-horsepower. Steam is supplied by two Yarrow boilers.

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The Economy of Superheated Steam.

Reliable data, giving an exact comparison of the performance of a marine steam engine when using saturated and when using superheated steam, are not very plentiful, and, consequently, the very complete and accurate tests which were made on the steam yacht *Idalia* to determine the economy of using superheated steam, the results of which are published elsewhere in this issue, deserve careful consideration. We have pointed out in previous issues that the steam consumption of a marine turbine can be reduced approximately one percent for each 10 degrees Fahrenheit of superheat, and that nearly as good results can be expected with reciprocating engines. The tests on the *Idalia* bear out these conclusions remarkably well, for they indicate that a net gain of 10 percent in heat consumption may be obtained by superheating 100 degrees Fahrenheit, or that a saving of coal of one percent may be expected for each 10 degrees Fahrenheit of superheat. It is also pointed out that in cases where there are relatively large losses from condensation, as when running at low powers, the gain due to the use of superheat will be even higher. A gain of 12 percent in economy might confidently be expected in such cases with 100 degrees superheat.

Although the adoption of superheated steam for marine work has not been rapid, and many engineers have considered that the somewhat vague claims made for its advantages could not be realized in actual practice, yet in view of the results which have been achieved in recent years, it is evident that its claims can no longer be overlooked where economy in the operation of the marine steam engine is to be considered. The mechanical difficulties encountered in early installations have apparently been overcome, and in this connection it is interesting to note that the problem of lubrication was successfully solved on board the *Idalia* by the use of fine graphite mixed with water in the steam cylinders of both the main and auxiliary engines.

Shallow Draft River Steamers.

From recent developments in Congress it is probable that the people of the United States will soon be committed to the expenditure of enormous sums of money for the improvement of their inland waterways and navigable rivers to encourage transportation by water. The greater part of these expenditures will be for the widening and deepening of channels in the rivers and the maintenance of these channels at a uniform depth. Whether such enormous expenditures for this purpose will bring any adequate return on the investment or not is very problematical, since the development of river transportation does not depend alone upon the improvement of the waterways themselves. Just as important, and perhaps more so, are the development of landing and docking facilities and the establishment of warehouses and freight-handling appliances by the cities which form the terminals for this traffic. There are over 20,000 miles of navigable rivers in the United States, much of which has in the past been utilized for river transportation, with little or no improvement of the waterways themselves. On the Western rivers, in particular, up to 1864 there was a wonderful growth in river traffic; but since then this business, except for the transportation of coal, has steadily declined. The decline has been due, of course, to the competition of the railroads, and it was only during the period from 1845 to 1870, while the railroads were in the process of development, that river transportation attained its supremacy. However, as long as there was a demand for river transportation, fast passenger and freight boats and powerful towboats were designed and built which successfully met the existing conditions in the rivers, and transportation was carried on with little or no improvement in the waterways themselves.

In view of these facts, it seems as though the most logical way in which to upbuild the river transportation to-day is to improve the terminal facilities and

the type of carrier, and to maintain a clear channel in the waterways at approximately the depth which naturally exists, rather than to spend large sums of money in constructing deep channels to accommodate vessels of considerable draft. That the amount of freight which is likely to be transported by river can be carried on a shallow draft just as well as on a deep draft is generally conceded by river men and boat men. Millions of tons of freight are carried every year on navigable European rivers, where the depth of water is very much less than exists to-day in many of the large rivers in the United States. The average depth of the Rhine is 6 feet, and of the Elbe only 4½ feet; and yet millions of tons of freight are transported annually over these rivers. The average depth of the Mississippi from St. Louis to New Orleans is about 9 feet, and the average depth of its entire length is 6 feet; and yet it is maintained that this should be increased to 14 feet, in order to adequately develop its transportation facilities.

In connection with the improvement of waterways the Government proposes to carry out investigations to determine the best type of boat to be used for river practice. The stern-wheel steamer has long been pre-eminent for this work, and it is a type of boat which has been evolved by practical men to meet what are probably the most difficult requirements which any boat has to fulfill. The boat being pivotal about the wheel as a center, a uniform depth of immersion is always insured for the paddles, no matter how heavily the boat is loaded. Moreover, the maneuvering and backing qualities of the boats are exceptionally good, and these are requirements which are essential in river practice, where shifting channels, varying depths of water and lack of proper docking facilities frequently necessitate backing off from the banks or sand bars, etc. Although the main features in the design of stern-wheel river steamers are excellent, there is considerable room for improvement from an engineering point of view in the design of the main propelling machinery, and in this connection it is instructive to note some of the features of German river steamers.

The type of river boat used in Germany differs from the American river boat chiefly in the matter of engines and propellers. American river steamboats are the product of practical evolution rather than of scientific engineering design and, while they accomplish their work in a highly satisfactory manner from a practical standpoint, their engines show poor economy and leave room for considerable improvement. In German river steamers, on the other hand, the features which have proved so successful in American river boats have been adopted; but their engines and propellers have been designed with a view to good economy. The immense wooden paddle-wheels of the American boat, some of which are 30 or 40 feet in diameter and 30 or 40 feet wide, weighing as much as 160 tons, fitted with a large number of radial wooden buckets, are replaced on German boats by two steel feathering paddle-wheels of, perhaps, 12 or 13 feet diameter and 8 feet wide, with, at the most, seven buckets to a wheel, operating at a higher number of revolutions than the large, heavy wheels on American boats. The main engines of American steamboats are either simple or compound, long-stroke lever, poppet valve engines, using steam at high pressures and exhausting it also at high pressures, and, consequently, wasting a considerable portion of the available energy in the steam. As a rule, simple, non-condensing engines are favored, since compound condensing engines, although they cut down the fuel consumption, add so much in weight and take up so much space that they are usually not considered a profitable investment. The main engines of German river boats are usually either compound or triple-expansion condensing engines (depending upon the steam pressure used) of efficient design and moderate weight. The horsepower runs from about 500 to 750 in the smaller boats on the Elbe and Oder and up to 1,000 and 1,500 horsepower in the large boats on the Rhine. Records of fuel consumption show that these boats operate with an average coal consumption of only about 1¾ to 2 pounds of coal per indicated horsepower per hour for all purposes.

Tunnel boats, driven by screw propellers, have been tried to a certain extent for river work and have proved successful. The use of water-tube boilers, multiple-expansion engines and screw propellers makes at once a very large reduction in the weight of propelling machinery. In one case the relative weights of paddle-wheels and high-speed screw propellers were found to be 140 tons and 4½ tons. The weight of paddle-wheels on American river boats could, however, be considerably reduced if two steel feathering wheels of small diameter were used in place of the single large radial wheel now employed.

Marine Auxiliaries.

We are publishing this month a résumé of the development of auxiliary machinery on board ship and descriptions of many of the modern appliances which play such an important part in the economical operation of an up-to-date marine power plant. Of course, it is impossible to go into very much detail on such a varied and complex subject as this in a single article; but it is possible to mention the more important features and point out their relation to the plant as a whole. No auxiliary machinery has ever gained a firm foothold in the marine field until it has demonstrated that it is worth the extra cost and weight and space and added complication which it entails, and for this reason some of the refinements met in shore practice do not exist in marine work. In general, however, marine engine-room auxiliaries have been developed to a high degree of efficiency.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Jan. 1.	Feb. 1.
			BATTLESHIPS.		
Delaware ...	20,000	21	Newp't News Shipbuilding Co.	98.5	99.5
North Dakota	20,000	21	Fore River Shipbuilding Co..	98.0	98.6
Florida	20,000	20¾	Navy Yaard, New York......	46.4	50.5
Utah	20,000	20¾	New York Shipbuilding Co..	58.2	62.2
Arkansas ...	26,000	20½	New York Shipbuilding Co..	8.0	11.8
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	6.0	9.0
			TORPEDO-BOAT DESTROYERS.		
Lamson	700	28	Wm. Cramp & Sons.........	98.1	100.0
Paulding ...	742	29½	Bath Iron Works............	59.8	64.6
Drayton	742	29½	Bath Iron Works............	54.3	59.9
Roe	742	29½	Newp't News Shipbuilding Co.	70.8	73.0
Terry	742	29½	Newp't News Shipbuilding Co.	70.7	72.1
Perkins	742	29½	Fore River Shipbuilding Co..	64.8	65.3
Sterrett	742	29½	Fore River Shipbuilding Co..	64.4	65.0
McCall	742	29½	New York Shipbuilding Co..	42.1	48.1
Burrows	742	29½	New York Shipbuilding Co..	42.1	48.1
Warrington..	742	29½	Wm. Cramp & Sons.........	58.0	60.3
Mayrant	742	29½	Wm. Cramp & Sons.........	58.8	60.9
Monaghan ..	...	..	Newp't News Shipbuilding Co.	7.4	10.1
Trippe	...	..	Bath Iron Works............	13.5	18.4
Walke	...	..	Fore River Shipbuilding Co..	9.9	11.9
Ammen	...	..	Fore River Shipbuilding Co..	10.9	12.4
Patterson ...	...	..	Wm. Cramp & Sons.........	6.7	9.1
			SUBMARINE TORPEDO BOATS.		
Salmon	...	..	Fore River Shipbuilding Co..	90.4	90.6
Seal	...	..	Newp't News Shipbuilding Co.	34.1	36.6
Carp	...	..	Union Iron Works..........	35.6	39.1
Barracuda ..	...	..	Union Iron Works..........	35.3	39.1
Pickerel	...	..	The Moran Co..............	32.0	36.9
Skate	...	..	The Moran Co..............	32.0	36.9
Skipjack	...	..	Fore River Shipbuilding Co..	13.6	16.8
Sturgeon ...	...	..	Fore River Shipbuilding Co..	13.5	16.6
Tuna	...	..	Newp't News Shipbuilding Co.	12.3	14.0

ENGINEERING SPECIALTIES.

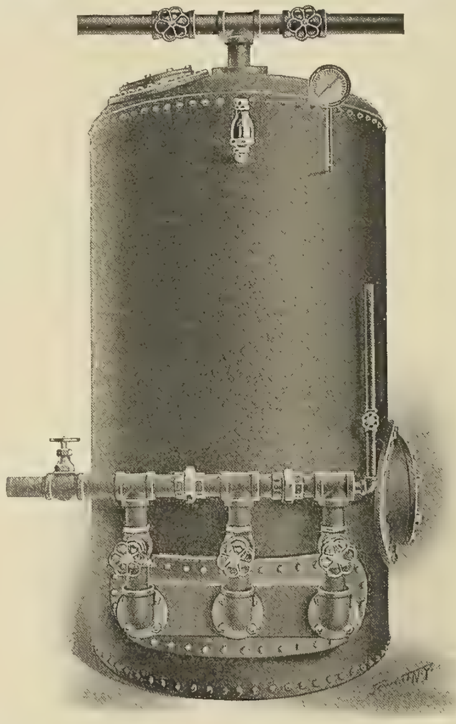
Krause-Miller Absorbent Condensation Filters.

Steamboat owners and marine engineers generally will be interested in the results obtained with the Krause-Miller absorbent condensation feed-water filter installed on Dredge *No. 2,* belonging to Walter A. Gahagan, at Far Rockaway, L. I., where some extensive dredging and large reclaiming operations are in progress. The special function of this filter is to remove the last traces of oil or grease from the condensed water, leaving it clear and bright, and thus avoiding the dangers attendant on feeding oil or grease into steam boilers, such as the risk of burning out tubes, bulging furnace plates and possible explosions.

Innumerable attempts have heretofore been made to satisfactorily clarify and totally remove the last traces of grease from condensation, but many of these have succeeded only in removing the coarse or floating oil from the water by means of skimming tanks, sawdust, excelsior, Turkish toweling, and other straining methods. Experience has, however, shown, that it is not sufficient or safe to remove only the coarse oil, and that the milky looking or emulsified oil must also be completely removed in order to render the water perfectly safe for boiler use.

A careful analysis of the condensation from the Ball & Wood engine on Gahagan's dredge, showed that the coarse or floating oil had been entirely removed, but that the milky or emulsified oil, which would readily pass through any of the numerous cloth or other filters, still contained seven parts of oil per 100,000 parts of water, or, in other words, as much as 4.06 grains of oil per gallon. The appearance of this water was cloudy and semi-transparent when viewed through a glass bottle 1½ inches in diameter. As the boilers on the dredge were being fed at the rate of 1,506 gallons per hour, the amount of grease with which they were being charged per day of 11 hours, previous to filtration, amounted to 9.46 pounds, or 1 1/3 gallons. In a month of twenty-six working days, this might therefore easily amount to 34½ gallons. The evil results of such a quantity of oil pumped into a boiler every day can best be appreciated by experienced engineers and needs no further comment, except to say that with even a fraction of the above original amount of oil in the feed water, say only ½ grain per gallon, the amount of oil entering the boiler per month would still be undesirable, if not unsafe.

In the condensation filter now installed on the Gahagan dredge, and which, it is claimed, is delivering the water absolutely free from any traces of oil and perfectly clear, the filtering material used consists of a non-soluble fibre, which has a strong absorbent or physical attraction for oil, retain-



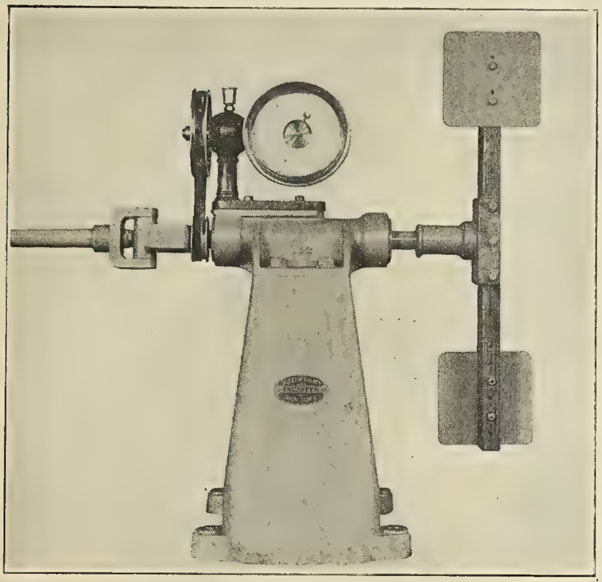
ing within its pores from 20 to 50 percent of oil. There are no chemicals used, nor any expert attendance necessary, and the material lasts a very considerable time without change. In a filter 36 inches diameter by 5 feet in height, made on these principles, which has been in use for seven months in the Miller Brothers shop, and through which have passed in the last six months 3,000,000 pounds of water, they are still getting perfectly clear feed water according to chemical analysis. The expense of its operation during this period has been not over $4, it not having been found necessary in that time to renew the filtering material, the only expense having been the attention of the engineer for 15 minutes every three weeks to reverse the current and free the top of the filter from the accumulated oil.

These filters are manufactured by Alex. Miller & Bro., Jersey City, N. J.

A Fan Dynamometer.

The standard type of fan dynamometer illustrated has been placed on the market by Joseph Tracy, consulting automobile engineer, 116 W. Thirty-ninth street, New York. It consists essentially of a metal standard carrying a horizontal steel shaft in large ball bearings; one end of this shaft is connected to the motor under test by a universally jointed extension shaft, the other end carries an overhung two-bladed fan. On the dynanometer shaft a small pulley fitted to a boss on the rear of the universal joint is belted to a larger pulley on the special tachometer, which is mounted on top of the housing that carries the dynamometer shaft.

The tachometer is provided with a double scale and single pointer; the inner scale showing the revolutions per minute, and the outer scale the horsepower developed. The revolutions per minute scale is graduated, progressively, by divisions of 20 revolutions from 200 to 2,000. The horsepower scale gives a minimum reading of 1 horsepower at 480 revolutions, and a maximum of 70 horsepower at 1,980 revolutions. Consequently at all ordinary rates of motor speed a simultaneous



reading of revolutions per minute and horsepower can be obtained without any computation.

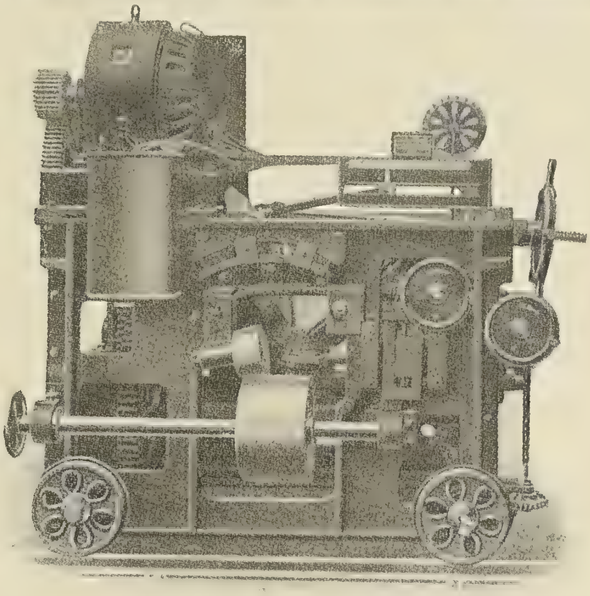
The dynamometer can be employed in testing motors on the block by making suitable connection between the jointed dynamometer shaft and the motor shaft, clutch or flywheel. It can also be used to test an automobile motor in position on the chassis by disconnecting the propeller shaft and substituting for it the jointed shaft of the dynamometer.

The apparatus is designed to test motors of medium size. However, by the use of fan blades of greater or less area, and suitable tachometer scales, the range of absorption and measurement of power can be varied between wide limits.

Davis Beveling Machine.

The common method of beveling bars by hand labor, besides being expensive and unsatisfactory, is also injurious to the material. In beveling a bar, the angle has, in the first instance, to be guessed at by the workman; then altered back or forward, until it conforms with the bevel obtained from the body plan of the ship. It follows that the best heat has gone from the bar before this can be done—and when the bevel is extreme, the bar, before being finished, has to be heated, in some cases, several times; in consequence of which the metal becomes brittle and unsatisfactory, the flanges hollow, and the edges unfair. It is drawn and disfigured by hammering, and the holes in the beveling slabs are imprinted on the outside surface, so that when the work comes to be put together it cannot fay close; and when the riveters attempt to close up the work with the aid of quarter hammers, they often finish by breaking or fracturing it.

The Davis patent beveling machine, manufactured by Davis & Primrose, Etna Iron Works, Leith, has been designed to obviate the foregoing evils. The machine is mounted on rails in front of the furnace, and when needed it is brought up opposite the furnace mouth. It draws the bar out of the furnace and does the beveling when the bar is at its best heat. It is also claimed that it smooths down the rough edges of the rivet holes, so that the rivet head gets close up at neck, and the work fays close; the operation being done by rollers when it is hot, the edges of the bar are fair, and free from local strains. The time occupied by beveling being so short, the bar, when it has left the machine, is sufficiently hot to be turned without reheating. For frames and other work, the bevels are taken from the body plan of the ship at regular intervals along the bar, the spot numbered, as usual, the angle at each number or



spot is measured, and the numbers transferred to the corresponding angles on the bevel board. On the machine is what is termed the bevel index, which is graduated into degrees from 90 to 45 degrees. The angles which have been marked on the bevel board are then indicated by their numbers on the bevel index of the machine, in their relative positions, measuring from the end of the bar. It is claimed that the machine saves about 50 percent of the labor on such work.

Automatic Cut-Off Valve.

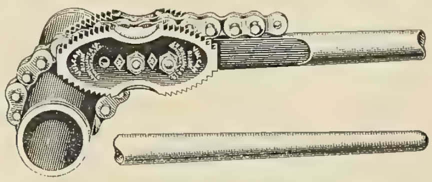
Harmful results, due to escaping steam, from failures in watertube boilers can be successfully prevented by installing an automatic cut-off valve. When one of these valves is installed between each boiler and the steam header, it forms an automatic stop, no matter where the break may occur. The valve illustrated herewith, manufactured by the Lagonda Manufacturing Company, Springfield, Ohio, is of the double-acting type; that is, it works equally well in either direction. Should a single tube in one boiler give way, this valve would instantly isolate that boiler. On the other hand, if a break occurs in the steam main between the boiler and the engine, or, for that matter, in any part of the steam loop, all of the valves instantly close, preventing escape of steam. This valve depends for its action upon the actual flow of steam, and not upon the differences in pressures, and whenever abnormal flow occurs in either direction, it is claimed that the valve instantly shuts. It takes the place of the ordinary stop valve, and can be used as such, but should not be confused with the ordinary single-action, non-return valve. One important feature of the Lagonda valve is, that there are no internal working parts. A dash pot is fitted on the outside to prevent chattering, or the closing of the valve too quickly when sudden overloads occur.

Tests of this valve made in Washington, D. C., before a Board of Supervising Engineers of the Department of Commerce and Labor showed that when an opening was made be-

tween the valve and the boiler, equivalent to an outlet 1 5/16 inches in diameter, the valves closed promptly. To show the action when a break occurs on the other side of the valve, a quick release valve was opened, corresponding to an outlet of 1½ inches in diameter. It is reported that the valve closed in 2 seconds, and the steam pressure was only reduced from 180 to 140 pounds, the rush of steam closing the valve. Other interesting tests were made to prove the reliability of the valve. To test its action under sudden overload a quick-release valve was opened corresponding to an opening of 1½ inches. Thirty seconds was consumed in opening the quick-release valve this time, and the steam pressure dropped from 180 to 90 pounds, but the automatic valve remained open. These tests prove that the valve can take care of any unusual but legitimate demand for steam, and still be sensitive enough to close quickly in case of accidents. By means of the dash pot and weight the valve can be adjusted to suit the local conditions of steam pressure and overload. The board of supervising engineers who witnessed these tests approved its use in all marine service. The valve is built in sizes from 3 to 12 inches. A special "low-down" type is made for use where headroom is limited on board ship.

Vulcan Bijaw Chain Pipe Wrenches.

J. H. Williams & Co., Brooklyn, N. Y., who, since 1884 have been developing chain-pipe wrenches, have just brought out a new wrench known as the "Vulcan Bijaw." This wrench is made with double-ended reversible jaws, which can be readily turned end for end when the tool wears, thus doubling the life of the tool and insuring that it will be always ready for service. Two studs or bolts through the

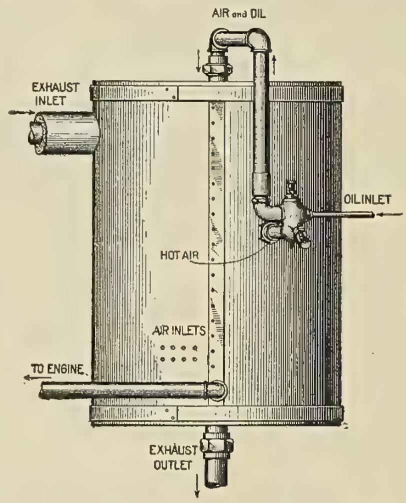


handle prevent the spread of the jaws when in use. The material in these studs is of great strength, and in case of accident repairs may be made on the spot by moving forward the rear stud, since it is claimed that one bolt or stud will still provide working strength for the tool. The application of the jaws to the handle remains the same milled construction which has given satisfaction for so many years in the "Vulcan" wrenches manufactured by this company. These wrenches are made in sizes for ⅛ to 12-inch pipe and fittings, with interchangeable cable or flat-link chains.

The Hydrocarbon Converter.

Recent activities in the marine producer-gas field have been confined entirely to the use of coal as a fuel. A new application of this principle is now being brought out, however, by the Hydrocarbon Converter Company, 37 Wall street, New York, who are placing on the market an apparatus for the gasification of fuel oil. By means of this apparatus, which is called the hydrocarbon converter, it is claimed that the oil is completely gasified and that the gas can be delivered to the engine at high temperature, where, upon mixing with the proper amount of air, the usual explosive mixture is formed. The value of this converter is evident when the comparative cost of different liquid fuels is considered. In New York markets gasoline (petrol) may be quoted at 14 cents (7 pence) per gallon, kerosene (paraffin) 7 cents (3.5 pence) per gallon, and fuel oil 3 cents (1.5 pence) per gallon, while in Europe gasoline (petrol) ranges from 30 cents (1/3) per gallon upward. Not only is the cost of the fuel an advantage but the ease of handling and safety of using fuel oil as compared with other liquid fuels and with solid fuels are important considerations in marine work.

The converter comprises a nest of three cast iron cylinders, one within another, thus making three compartments, an inner, a middle and an outer. The apparatus being suitably installed in connection with the engine, as is a carbureter, the exhaust pipe is connected to the middle compartment through which the hot waste gases circulate and find an outlet through a continuation of the exhaust pipe on the other side, the inner and outer compartments becoming highly heated by radiation from the middle compartment. The inner compartment contains a channeled nest of cylinders of crucible material which is of a minutely porous character. Under the heat communicated from the middle compartment these porous cylinders quickly absorb and retain a high temperature. Air is introduced through orifices into the outer chamber, where it also is highly heated, and then passes out through a pipe which unites with



a pipe from the oil supply tank, and there is then drawn through them into the inner compartment by the suction of the engine, a mingled stream of oil and air. In passing through the channels of the hot porous cylinders in the inner compartment, the oil is gasified, the final product being an airified hydrocarbon gas of high temperature, which is delivered to the engine by a pipe passing from the center of the inner compartment. The heat of the inner compartment is supplemented by slow and more or less incomplete combustion of some of the constituents of the oil and the oxygen of the air, resulting principally in formation of carbon monoxide, and which maintains a considerably higher temperature in the porous cylinders than that of the engine exhaust gases.

The converter contains no moving parts, and does not require the use in connection with it of a fan or blower, such as is commonly used with coal gas producers or in such special types of engines where the fuel is fed under high compression. The suction of the engine is the controlling power that automatically regulates the flow of oil and air into the converter and the gas from it; when once started in operation practically no attendance is required. The engine can be started either on gasoline or by a preliminary heating of the converter by means of a torch.

The complete gasification of any oil is apparently dependent upon a division of its mass into most minute fractions and subsequent submission in that state to a high temperature. Methods heretofore in use for the breaking up of the oil have been mechanical, and such as to produce a spray or liquid vapor or mist, each globule of which upon exposure to the required heat undergoes chemical transformation, but unless the heat penetrates to the center of the globule, so that its action is uniformly effective throughout, such transformation is not complete, only the more volatile contents gasifying and

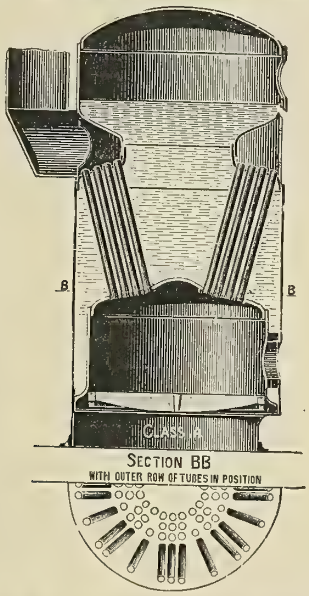
the heavier carbon compounds remaining unchanged. It is claimed that the hot porous cylinders of the hydrocarbon converter absorb the oil, and within their pores it is so divided and sub-divided into microscopic particles that it may nearly approach a true molecular distribution, and in such an extremely fine state of division, and with each minute particle surrounded by the hot walls of the pore cell, the applied heat penetrates so evenly and effectively that the chemical transformation of each particle to gas is complete.

The apparatus has been installed for several months upon a 78-foot yacht driven by a 70-horsepower Twentieth Century engine. Comparative tests on this yacht, using first gasoline (petrol) as a fuel and then gasified fuel oil, resulted in the use of 12.125 gallons of gasoline (petrol) per hour, costing $1.697 (7/1), and only 5 gallons of crude oil per hour, costing $0.15 (7.5 pence) for the same service. An analysis of a sample of the gas taken from the converter showed the following percentages of constituents: CO_2, 7.6; O, 1.2; illuminants, 9.4; CO, 3.1; H, 1.9; CH_4, 7.5; N, 69.3; calorific value of the gas, 286 British thermal units. The gas is delivered to the engine at a temperature ranging from 600 to 1,200 degrees F., and a compression of about 80 pounds per square inch is used in the engine.

Although the immediate principal application of the hydrocarbon converter will undoubtedly be in connection with the gas engine, yet it has a number of other important applications, for it is claimed that by means of it oil fuel can be successfully fired under steam boilers and in various industrial furnaces, and also that a good illuminating gas can be produced by it.

The Genetic Boiler.

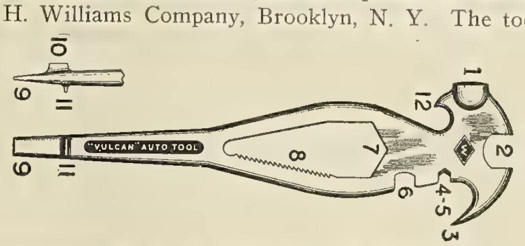
A small vertical multi-tubular boiler, which is used as a donkey boiler on large vessels and as the main boiler for steam yachts, launches and smaller boats, is made by Messrs. T. Toward & Company, at the St. Lawrence Iron Works, Newcastle-on-Tyne. This boiler is known as the Genetic, and, as



can be seen from the illustration, consists of an upright cylindrical shell, 11 feet by 5 feet, with a combustion chamber formed in the bottom of it, from which extend a number of fire tubes arranged in circles, communicating at their upper ends with an annular chamber connected with the chimney by a series of tubes. The effective heating surface is given as 330 square feet, and the boiler is stated to be capable of evaporating 10 pounds of water per pound of coal. The inventor of this boiler claims that its construction is both simple and exceptionally strong, since there are no flat surfaces and no parts which are subject to undue deterioration. It is claimed to be easily accessible for cleaning and repairs, and to have a high evaporative efficiency, besides occupying only a small space.

The Vulcan Auto Tool.

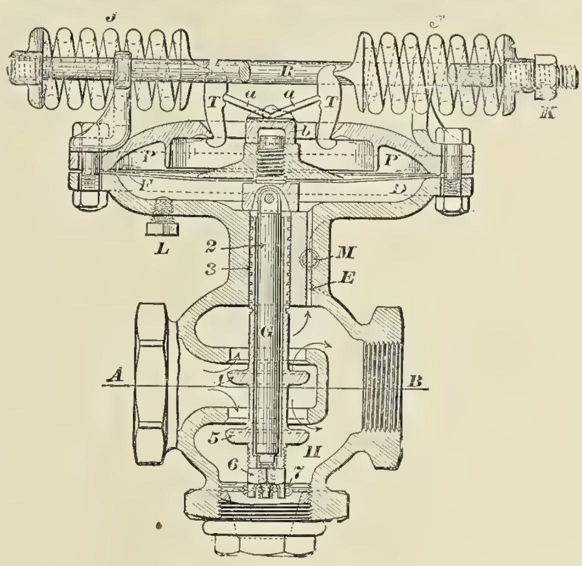
The illustration shows a handy tool for the motorist or motorboat owner, which has just been placed on the market by J. H. Williams Company, Brooklyn, N. Y. The tool has



no moving parts, yet it can be used for the following purposes: hammer, a tire lug wrench, cotton pin puller, gas-tank wrench, wire insulation scraper, air-tank wrench, spark-plug wrench, alligator wrench, cotter pin spreader, three screw drivers and a bottle opener.

Foster Patent Reducing Valve.

The most serious objection to reducing valves using a compression spring is the fact that the power of the spring is never the same under two different degrees of compression, hence it is evident that any change in the position of the valve in relation to its seat causes also a change in the power of the spring; thus such a reducing valve will not open beyond a certain point unless the pressure on the reduced side falls. In order to overcome this difficulty, W. H. Bailey & Company, Ltd., Albion Works, Salford, Manchester, have placed on the market a full-bore pressure reducing valve, which, it is claimed, can open full-bore, if necessary, and yet



prevent the reduced pressure rising above that at which the valve is adjusted, so that if a demand for more steam be made on it it instantly opens wider and supplies that demand but maintains a uniform reduced pressure.

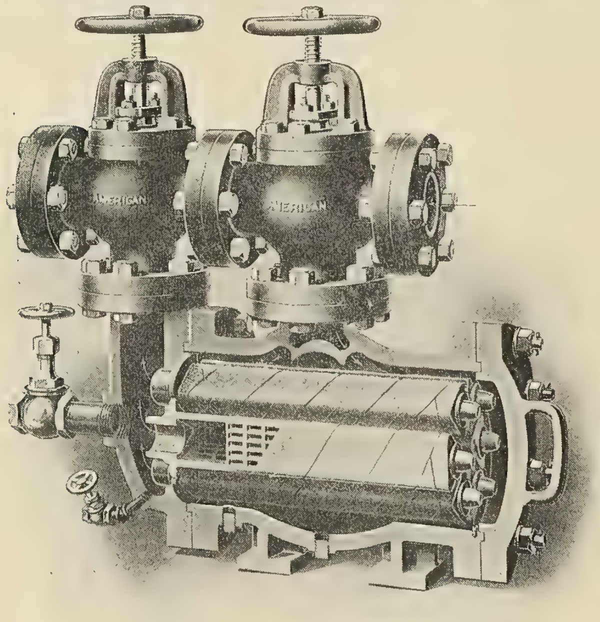
The constant and uniformly-acting power needed to resist the closing of the valve is secured by interposing toggle levers between the diaphragm and spring. The increasing power of the spring, as it is compressed, is compensated for by the increasing power of the toggle levers as they come into line.

This reducing valve is provided with a balanced valve so constructed as not to become distorted under varying condi-

tions of temperature and pressure. The construction of this valve may be briefly described as follows: First, the body of the valve is so made that the inner and outer casings are connected with expansion-resisting webs, which carry off the heat by radiation equally on all sides and thus prevent distortion of the seats. Second, the elongation of the neck between the two clappers is compensated for by making the upper seat almost flat and the lower seat nearly straight (15 degrees off the vertical line). By this means the upper seat is brought to its bearing by the force of the delivery pressure acting on the diaphragm, while the lower seat finds its bearing by diametrical expansion.

The American H_2O Grease Extracting Feed Water Filter.

The illustration shows a grease extracting feed-water filter manufactured by the American Steam Gauge & Valve Manufacturing Company, Boston, Mass. It consists essentially of a number of filtering cages placed radially in a casing, the cages being covered with Turkish toweling (linen Terry),



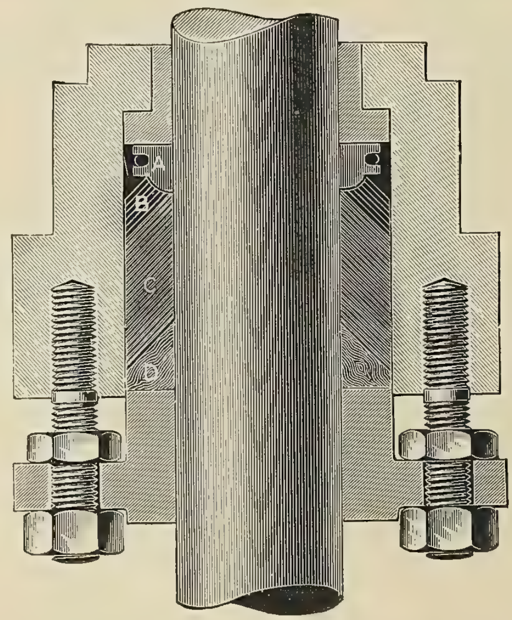
providing an exceptionally large surface through which the feed water passes. The total surface area of the covered cages is 320 times the area of the feed-water pipe, so that the opportunity for clogging is very remote. The filter is simple in construction and admits of easy renewal of the covering for the cages when necessary. The filter is provided with a special attachment for applying a reverse current of steam, by means of which a large proportion of the oil collected may be instantly blown out and drawn off through the drain cock.

The Sentinel Multiple Feed Water Filter.

The "Sentinel" multiple feed-water filter and oil separator, manufactured by Alley & MacLellan, Ltd., of Glasgow, consists of a vertical cylinder carrying a casing at the bottom, which is free to swing about a central vertical shaft. Projecting up from this casing are perforated brass tubes placed radially. Each of these tubes carries a filtering mantle, which is made of cocoanut fiber, a material which it is claimed has a great affinity for oil, and since it is of a porous nature, four-ply of fiber can be used around each mantle holder without the risk of chocking the filter. This apparatus provides a filter surface 250 times the area of the feed-water pipe. It is also very convenient for cleaning, since the casing carrying the filtering mantles can be swung about and each mantle removed in its turn through a small opening in the cover.

Christie's Galvanic Metal Packing.

W. Christie & Company, 50 Wellington street, Glasgow, manufacture a metallic packing which consists principally of a series of thin rings of pure galvanic deposits of nickel and copper sewn together in sections of from ¼ to ¾ inch deep. This packing is claimed to be exceptionally good for excluding air from the glands of low-pressure cylinders, or in any place where a packing is needed for low-pressure glands. As the packing is made in conical or funnel shape, it acts automatically under steam pressure, the inner edge being pressed against the piston rod and the outer edge against the



wall of the stuffing-box. Where this packing is used it should be fitted as shown in the cut. First, a white metal cuff in two pieces, held together with a spring, is inserted, and then one or two collar rings *B*, especially cut to go over the body of the cuff. Next, are placed the galvanic metal packing rings, as shown at *C*, the joints being varied about one-third of the circumference in their relative positions. Finally, after the stuffing-box has been packed full, a closing ring *D* of asbestos is inserted, in order to preserve the packing at its correct angle.

TECHNICAL PUBLICATIONS.

The Mechanical World Electrical Pocketbook for 1910. Size, 4 by 6. Pages, 271; figures, 65. Manchester, 1910: Emmott & Company, Ltd. Price, 6d. net.

This pocketbook is issued annually, and each new edition is thoroughly revised and brought up to date. In the 1910 issue large additions have been made to the sections on electric lamps and lighting, and new sections have been introduced on motor converters, carrying capacity of cables, cheap house wiring, conduit system of wiring, etc. The book comprises a useful collection of data for electrical engineers.

The Mechanical World Pocket Diary and Year Book for 1910. Size, 4 by 6. Pages, 391; figures, 67. Manchester, 1910: Emmott & Company, Ltd. Price, 6d. net.

This handy little mechanical engineer's pocketbook is now in its twenty-third edition, and, in addition to the features which have made it popular in previous years, some new material has been added on oil engines and the design of cen-

trifugal pumps. Other additions include such subjects as ball bearings, dimensions of marine boilers, tapers and angles, change wheels for cutting metric pitches, hobs for cutting involute gears, dimensions of ring oil bearings, notes on double helical gears, bevel, spiral and worm gears, emery wheel speeds, etc. Various other tables and data have been introduced and the work revised generally.

Bureau Veritas, 1909-1910, Repertoire General. Two volumes. Size, 10¼ by 11¼ inches. Pages, steamers, 1,125; sailing vessels, 1,047. Paris, 1910: 8 Place de la Bourse, or London, E. C., 155 Fenchurch street. Price, complete, £3 3s. ($15); steamers, £1 15s.; sailing vessels, £1 10s.

This is the fortieth edition of the general list of merchant shipping of all nations issued annually by the Bureau Veritas. The size of the book has been changed this year, making it somewhat more convenient to handle. The tables and contents, however, remain the same as in previous years. The list of steamers includes general statistics of each flag, statistics of steamers built, bought and sold in the principal countries during the year, a list of the steamships of all nations, tables of changes of names, new steamers, etc., a list of steamers carrying petroleum in bulk, a list of cable vessels, an alphabetical list of steamers arranged according to tonnage, an alphabetical list of iron and steel shipbuilders, arranged according to the nationality, an alphabetical list of steamship owners, arranged according to the nationality, with the names and gross tonnages of their steamers, and a list of all drydocks, etc., in all ports of the world. The volume devoted to sailing vessels is arranged in practically the same manner as that for merchant steamers, except that there are separate lists for the owners of wooden vessels and for the owners of steel and iron vessels, and a list of vessels with auxiliary engines.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

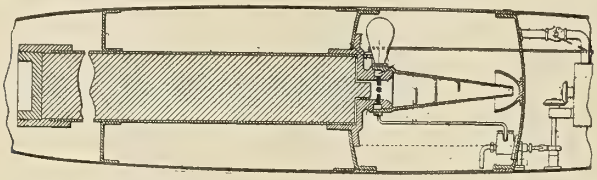
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

936,632. AUTOMATIC RELEASING DEVICE FOR BOATS. CHARLES HUNT, OF NEW YORK, N. Y.

Claim 1.—A launching device for boats having, in combination, a frame for attachment to a boat, a holding-bar journaled thereon, a locking-block co-operating with the bar, and a tripping-lever having one end in engagement with the frame, the lever and block being combined so as to enable the ene to release the other automatically by jarring the device. Four claims.

937,217. AUTOMOBILE TORPEDO. HUDSON MAXIM, OF BROOKLYN, N. Y.

Abstract.—The invention consists in the method of producing a motor fluid by burning a body capable of supporting its own combustion and employing the products of combustion to heat a liquid which is simultaneously passed through a chamber with the products of combustion, the unevaporated portion of said liquid being again passed through said chamber, where further evaporation takes place, and the unevaporated por-



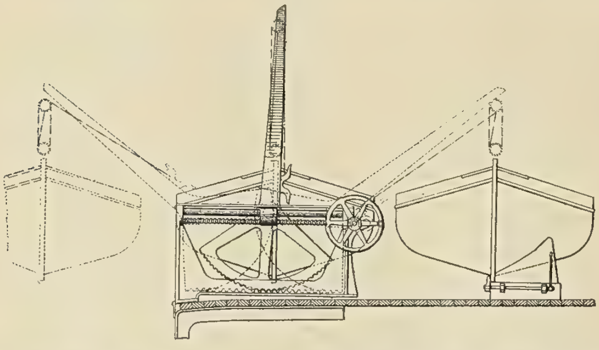
tion of the liquid, with its contained heat, is again circulated through the chamber, and thus continuously to the end that the temperature of the products of combustion is lowered to a point where it will not be injurious to the motor of the torpedo, and the heat is utilized for converting the liquid into steam, which is mixed with the products of combustion to form the motor fluid. Nineteen claims.

937,297. SYSTEM FOR GENERATING STEAM. CHARLES FERO, SR., OF BAY CITY, MICH., ASSIGNOR, BY MESNE ASSIGNMENT, OF ONE-HALF TO IGNATIUS ANDRZEJEWSKI, OF BAY CITY, MICH.

Claim.—An auxiliary steam generating attachment for steam boilers comprising a fluid receiving tank adapted for arrangement in a combustion chamber, means for supplying fluid thereto, a discharge pipe connected at one end to said tank, a perforated pipe connected with the other end of said discharge pipe and of a length sufficient to extend through opposite ends of the boiler to which it is to be applied, a tank adapted to be arranged in the boiler smokestack and connected to one end of said perforated pipe, the other end of said pipe being designed to project outside the boiler and provided with a valve for regulating the fluid supply, a pipe leading from said smoke stack tank into the boiler bent to form connected inverted U-shaped members, the uper portion of said U-shaped members having downwardly opening perforations, the legs thereof having laterally opening perforations and the connecting members having upwardly opening perforations whereby the fluid is forced through the water in the boiler in all directions to facilitate the rapid generation of steam. One claim.

938,447. DAVIT FOR HOISTING AND LOWERING BOATS. AXEL WELIN, OF LONDON, ENGLAND, ASSIGNOR TO WELIN QUADRA&T DAVIT, A CORPORATION OF NEW YORK.

Claim 1.—In a davit for hoisting and lowering boats, the combination of a davit arm having a toothed sector at its lower end, a rack on which



the sector may roll, and means for moving the davit arm to substantially an equal degree of inclination from the vertical in both directions. Fourteen claims.

938,911. PROPELLING MEANS FOR VESSELS. THOMAS B. TAYLOR, OF NEW YORK, N. Y.

Claim 1.—In a boat or vessel the combination of two separate, independently acting engines, two concentric shafts, a direct connection between one engine and one shaft, a direct connection between the second engine and the second shaft, two independent propellers of respectively opposite pitch, one on each shaft, and means for dividing one shaft, stopping one engine and connecting said shafts together. Fifteen claims.

937,433. STEAM-BOILER FURNACE. HENRY GALLAGHER AND GEORGE S. GALLAGHER, OF NEW YORK, N. Y., ASSIGNORS OF ONE-HALF TO SAID HENRY GALLAGHER AND ONE-HLF TO ARCHER P. GALLAGHER, BOTH OF NEW YORK, N. Y.

Claim 1.—In a steam boiler furnace, a boiler, inclosing and supporting walls therefor, grate bars, and a bridge-wall, said bridge wall being provided with an air flue extending across the same, a hopper-shaped recess in the top thereof and forward of the said air flue, a passageway leading from the space beneath the said grate bars to the said air flue, a soot flue leading from the said hopper-shaped recess in the top and to the rear thereof, and a series of apertures leading from the said air flue to the said hopper-shaped recess. Five claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

5,370. SCREW PROPELLERS. G. W. MAY, LONDON.

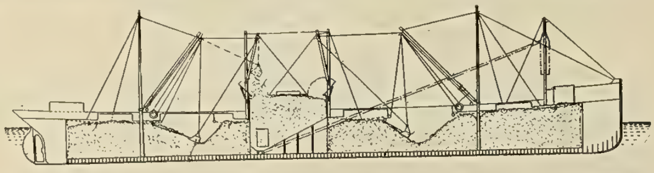
The inventor states that the churning of ordinary propeller blades causes air to be drawn into the water, so producing slip. To obviate this objection he constructs a divided propeller in which the blades are so disposed in respect to each other as to throw the exhaust spray at first quickly through the opening between two consecutive blades and then awash over that portion of the boss which carries the blade next starting on its working stroke. The centrifugal force of the wash causes the water to rush along the face of the blade, and thus to drive away the air which adheres to or is propelled by it.

6,126. PROPULSION OF SHIPS AND THE LIKE. C. DAY, GLASGOW.

The invention consists in the employment, as prime mover, of internal-combustion engines so arranged in conjunction with propellers and clutches and with electric transmission gear comprising a dynamo and motor that the speed of the engine can be controlled over a considerable range in one direction, allowing it to drive directly both at and considerably below the full "ahead" speed of the ship, and to drive electrically when lower speeds and reversing are desired; thus the power or capacity of the electrical gear need only be small relatively to the full speed power of the prime mover. The engine is coupled direct to the dynamo, and by a clutch with the propeller shaft, the motor being placed on the propeller shaft.

27,586. STORAGE VESSELS OR HULKS FOR COAL AND OTHER LOOSE MATERIAL. P. W. SIEURIN, GOTHENURG, SWEDEN.

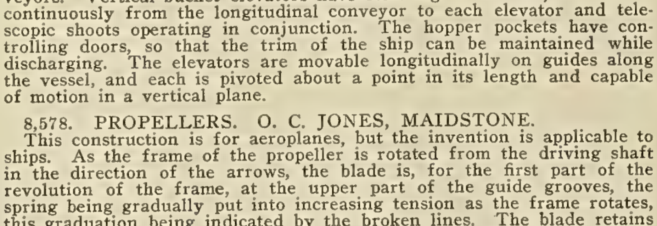
The vessel or hulk is provided with a hopper-like chamber from which the coal can flow to conveyors which carry it to shoots discharging over



the side into the holds of vessels along side, mechanically operated means also being provided for collecting coal from the hold of the storage hulk and delivering it to the hopper chamber ready for delivery.

28,555. COALING STEAMERS. J. MAYOH, WIMBLEDON PARK, SURREY.

The object is to provide a vessel to receive coal, steam to a port where vessels put in for bunker coal and there discharge into the bunkers of such a vessel without bringing it along side a quay, and that entirely without handling the coal. The hold has hopper-shaped pockets; sets of transverse conveyors, a bucket conveyor running partly longitudinally,



partly vertical and fed with coal from the hold by the transverse conveyors. Vertical bucket elevators have selecting mechanism, which feed continuously from the longitudinal conveyor to each elevator and telescopic shoots operating in conjunction. The hopper pockets have controlling doors, so that the trim of the ship can be maintained while discharging. The elevators are movable longitudinally on guides along the vessel, and each is pivoted about a point in its length and capable of motion in a vertical plane.

8,578. PROPELLERS. O. C. JONES, MAIDSTONE.

This construction is for aeroplanes, but the invention is applicable to ships. As the frame of the propeller is rotated from the driving shaft in the direction of the arrows, the blade is, for the first part of the revolution of the frame, at the upper part of the guide grooves, the spring being gradually put into increasing tension as the frame rotates, this graduation being indicated by the broken lines. The blade retains its position in the frame and the tension of the spring gradually increases until the blade just passes a plane containing the axis of the spring, then the tension suddenly pulls the blade to the opposite ends of the grooves, that is, to the ends of the grooves which are now in the uppermost position owing to the rotation of the frame.

26,289. SCREW PROPELLERS. C. COMA, MONTMAGNY, FRANCE.

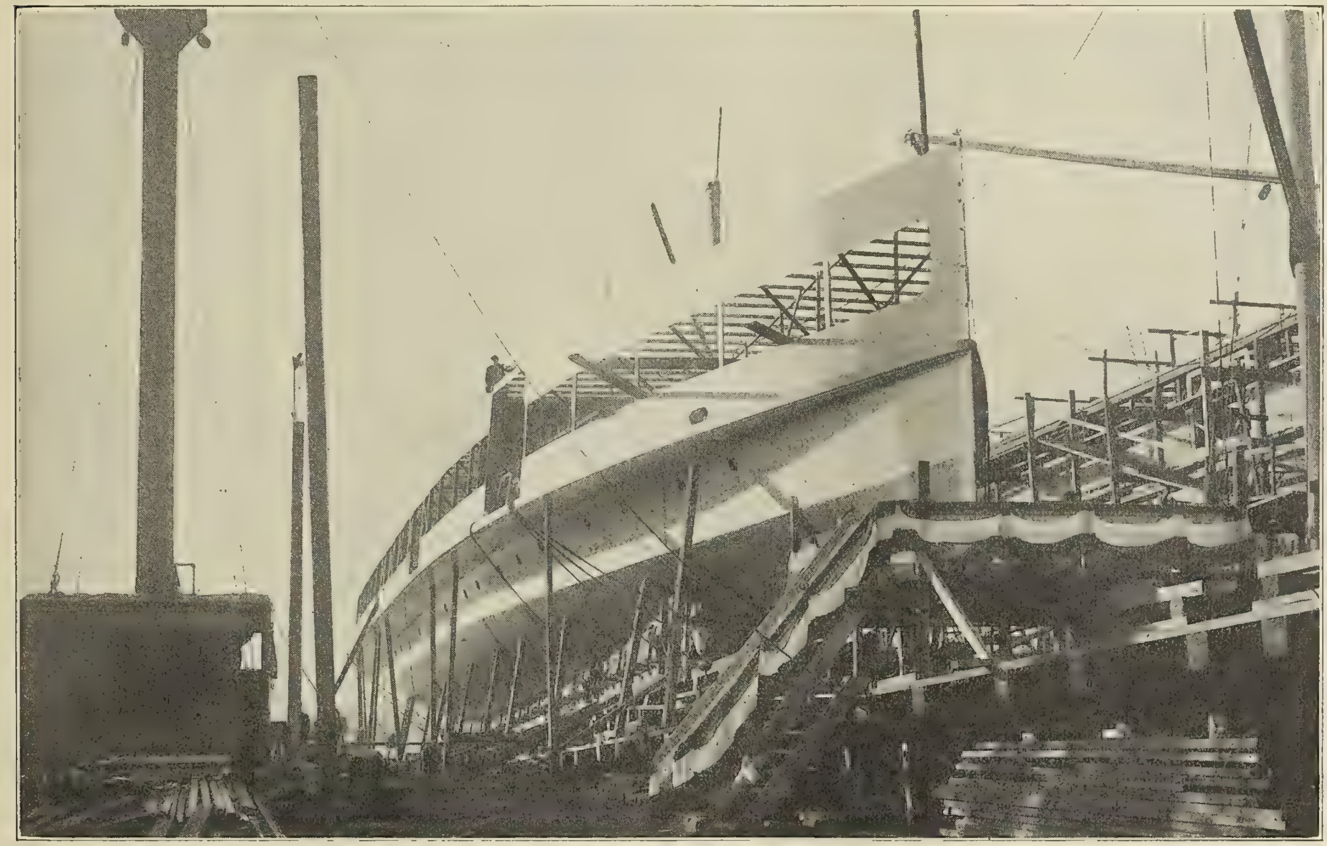
According to this invention, a number of propellers are placed one behind the other on a shaft, blades being arranged in overlapping succession very close behind one another. They are arranged in a helix and so proportioned and arranged with regard to the extent of overlapping that each succeeding blade receives the water current of that preceding without any whirling action. The water current is acted upon so that it passes through the whole helical channel and is all the time acted upon by the different blades without causing whirls, thus enhancing the efficiency. The drawing shows the new propeller arranged at the stem of the ship.

International Marine Engineering

APRIL, 1910.

THE NEW RIVER STEAMERS CITY OF PHILADELPHIA AND CITY OF WILMINGTON.

The increased traffic in passengers and freight between Philadelphia, Pa., and Wilmington, Del., has led the Wilson Line to construct two new river steamers. The two steamers which this company is running at present, the *Brandywine* and *City of Chester,* have had a splendid record. The *Brandywine,* a light built steamer, has been running every winter, and, contrary to what one would expect, is an acknowledged wonder at ice-breaking, being able to maintain her regular trips when vessels specially designed for the purpose of breaking ice have failed to make a passage. The increased traffic caused the owners to put the *City of Chester* in service this winter also, and by the middle of March they expect to have the new vessels, the *City of Philadelphia* and the *City of Wilmington* in commission. These new boats, like the older vessels, were built by the Harlan & Hollingsworth Corporation, of Wilmington, Del., who have had wide experience in this class of work. The new vessels have more powerful and heavier machinery, more freeboard, considerable more steel in their superstructures, and carry a larger load of passengers and freight, all this calling for more displacement, and, as the length was limited on account of turning in the Christiana River, a carefully designed vessel was necessary to fulfill all conditions imposed.



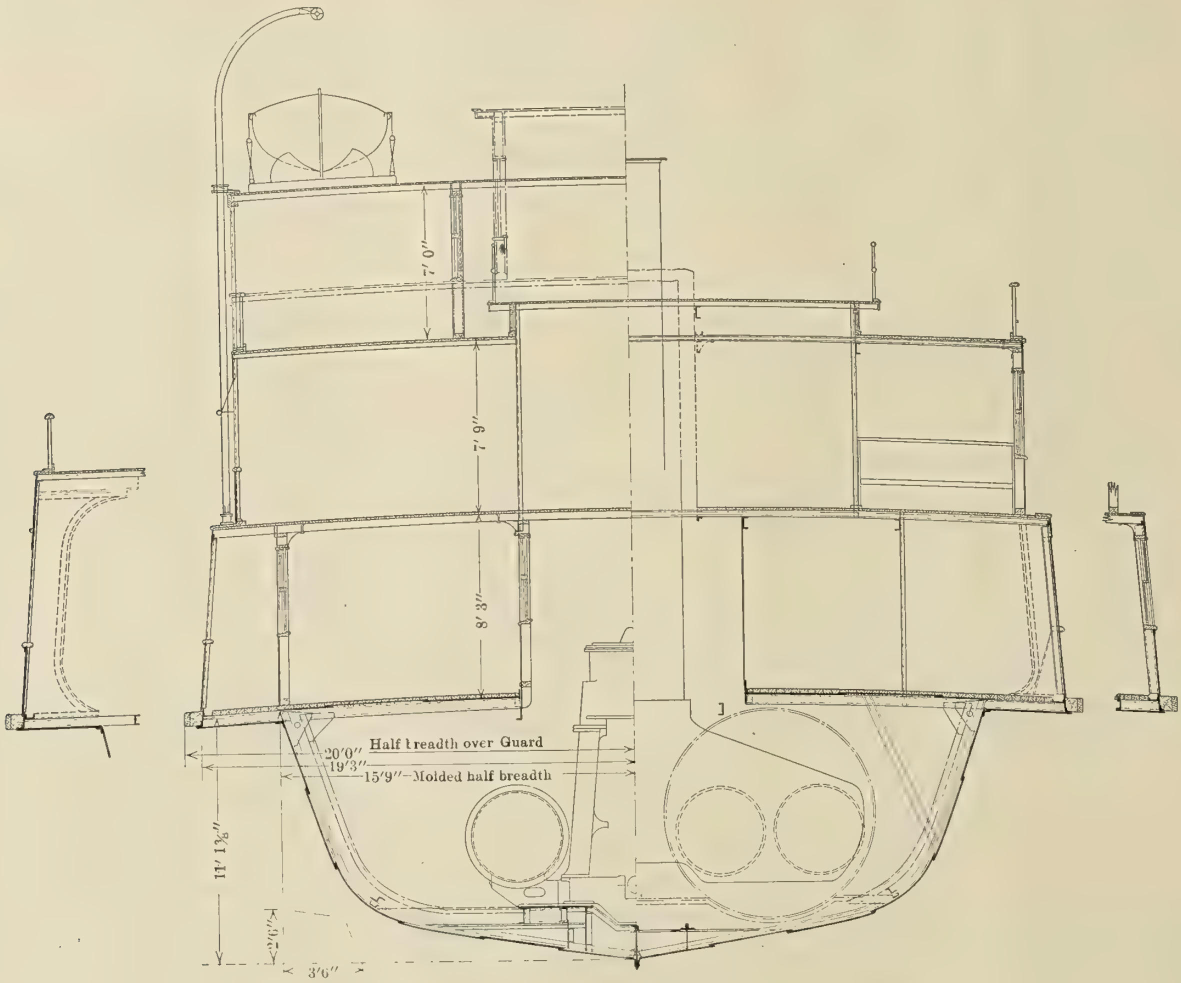
ONE OF THE NEW WILSON LINE STEAMERS READY FOR LAUNCHING AT THE YARDS OF HARLAN & HOLLINGSWORTH, WILMINGTON, DEL.

HULL.

The vessels are of the following dimensions: Length over all, 204 feet; length between perpendiculars, 186 feet; beam at deck, 31 feet; beam over guards, 40 feet; depth molded, 11 feet 4 inches. The hull is of steel, the heaviest plates being 25 pounds, and the lightest 5 pounds. The stern frame and rudder are solid steel castings. The frames are of angle section 6.6 pounds, having reverse bars in the machinery space. Bulkheads, belt frames and keelsons are fitted for stiffening the structure, the frames merely stiffening the shell. The deck beams are of Z-section, 11 pounds per foot, and are sup-

ported by girders and channel stanchions. The greater part of the main deck is covered with steel plating, as is the underside of the overhanging beams forming the guard, and there are no obstructions outside the shell, such as guard braces or brackets. The vessel is divided transversely by six watertight bulkheads, two of which have watertight doors. The engine seating is strongly constructed, of exceptional length, and is worked into the structure of the vessel. The freight enclosure is built of steel plates from 5 pounds to $3\frac{1}{2}$ pounds. The ladies' cabin and upper saloon, stairways, etc., are of a composite construction to decrease the weight which boiler room bulkhead and the steel bulkhead abaft, the crew's quarters, the kitchen, messrooms, and store rooms are located. The ice is taken in through a deck hatch, river and city water is led to the kitchen sink. Abaft the boiler room is the coal bunker, coal being taken in through rectangular hatches made to take a specially designed coaling barrow. Abaft the engine room is a space which may be used for a lower cabin or café. The quadrant is fitted to the rudder stock under the main deck.

On the main deck the entire space from the stem to the engine hatch is reserved for freight. The forward part of the

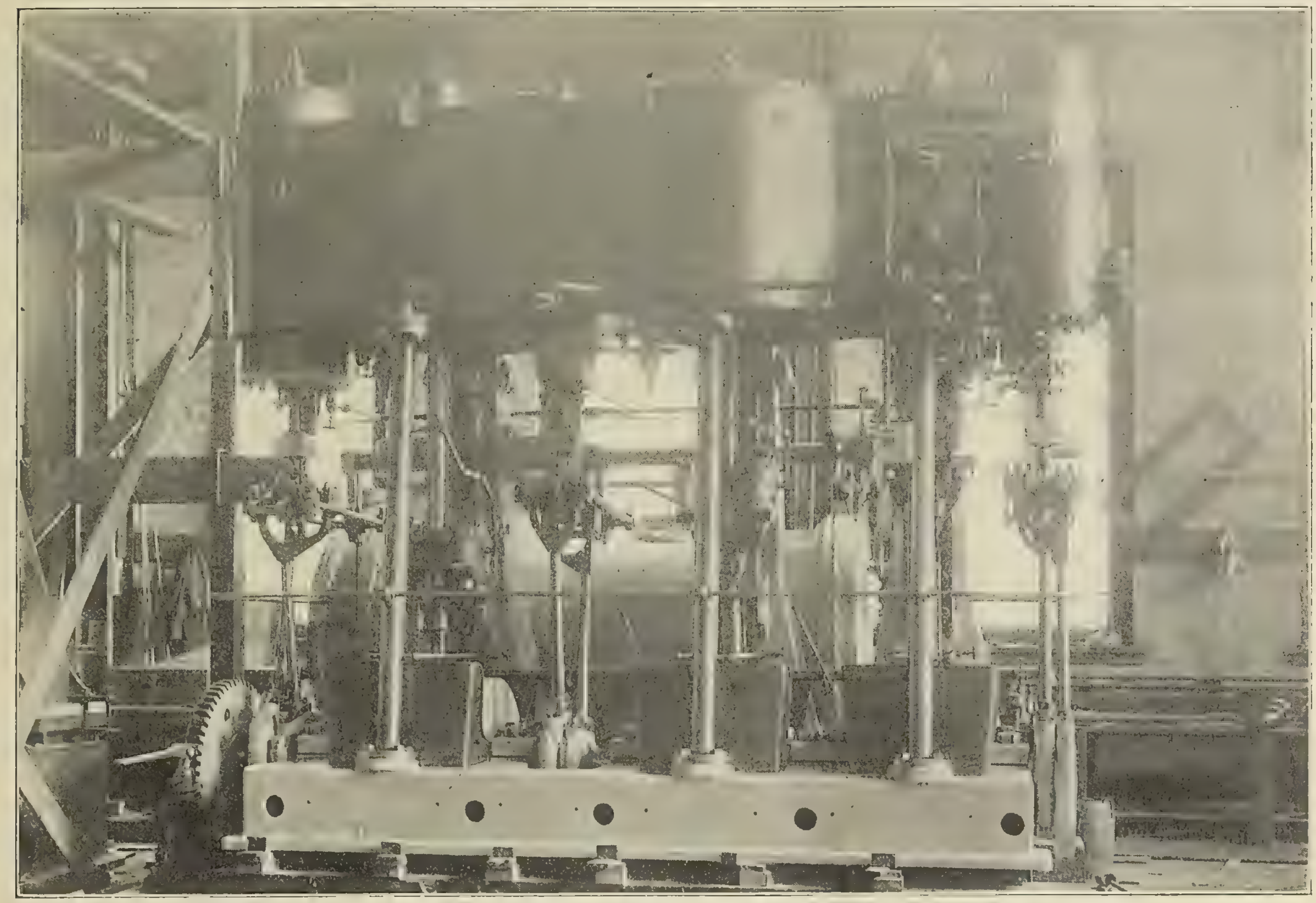


MIDSHIP SECTION OF THE CITY OF PHILADELPHIA AND CITY OF WILMINGTON.

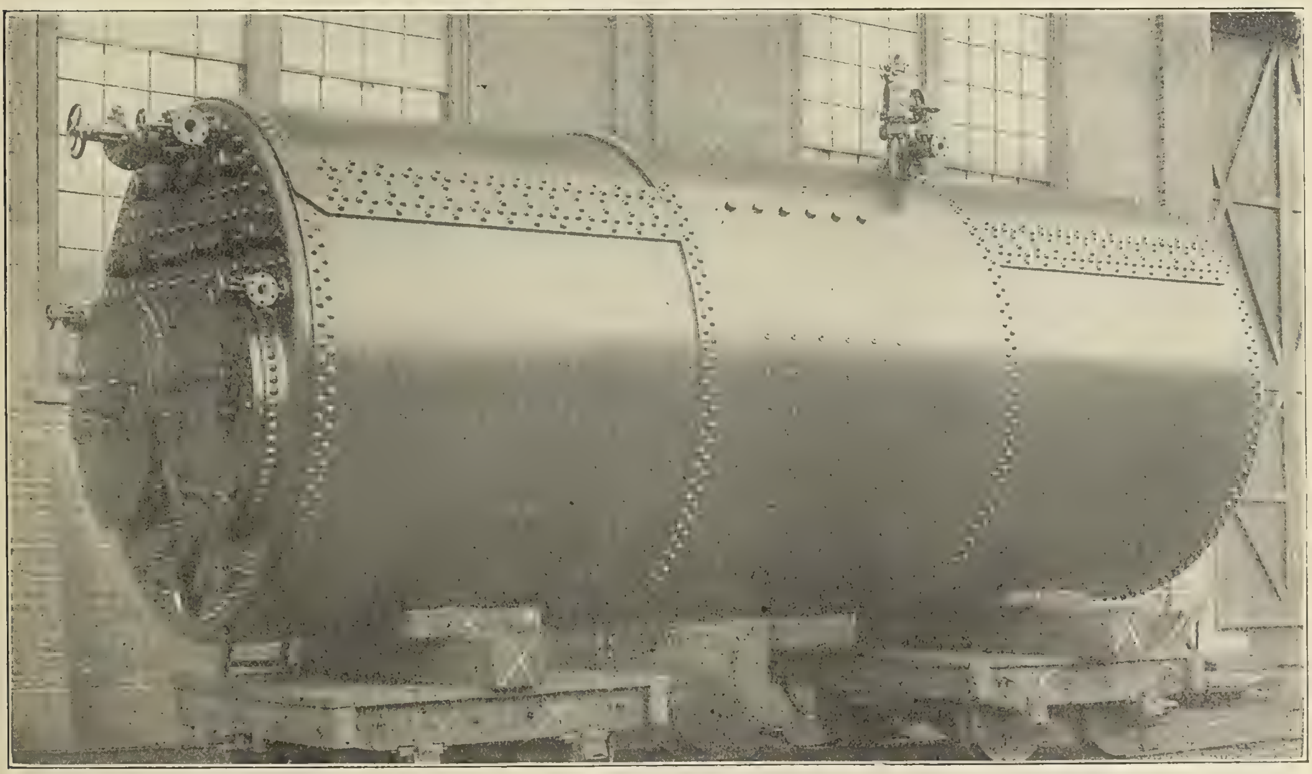
would result from an entire steel construction. Light iron is used for panel work. The main deck is sheathed with rift grain Oregon pine, the fender outside the guard is of oak. The upper decks are of wood, as are the carlins, but they are supported by steel girders and steel pillars, which do not step on any combustible deck, but are carried down to the hull of the vessel. The builders hope to eliminate vibration (felt in the older vessels in shallow water) in these new lighter, but more rigidly constructed, vessels, where every part is contributing to the general strength of the structure.

GENERAL ARRANGEMENT.

The general arrangement of the vessel can be seen from the accompanying plan. Below the main deck forward is the lamp room and chain locker in the fore peak; abaft this are the crew's quarters, fitted up with metal beds, metal lockers and wash bowls with running water. Between the forward deck, outside of the freight enclosure is covered over by the saloon deck, which is raised to the height of the saloon rail, and allows large furniture vans to be taken on board. The stanchions are widely spaced for this purpose, and by means of weather screens this place can be kept proof against wind and weather. Opposite the engine hatch on the port side is the baggage room, and on the other side the men's toilet. The social or entrance hall extends the full width of the vessel, the paneling here is of metal, the pillaring and stairways are simple but massive in baronial design. At the fore end of the hall, on the port side, the oyster bar is located, while the confection and cigar stand is on the starboard side. The captain's room, ticket office, purser's room and wireless telegraph office are situated at the aft end of the hall, with an entrance to the ladies' saloon or retiring room. The paneling of the room is in composite board, the floor is carpeted, the seats are upholstered in leather; pantasote shades of the railroad type



PROPULSION IS BY MEANS OF A SINGLE SET OF THREE-CYLINDER, TRIPLE-EXPANSION, SURFACE CONDENSING ENGINES.



EACH VESSEL IS FITTED WITH TWO GUNBOAT BOILERS; DIAMETER, 9 FEET 4 INCHES; LENGTH, 22 FEET; WORKING PRESSURE, 180 POUNDS PER SQUARE INCH.

are fitted in the windows; lockers, folding bed, and mirrors are provided, and immediately abaft is a large and airy toilet having a tiled floor and the most improved sanitary fittings. The stairways from the main to the saloon deck land in enclosed spaces and are protected from the weather, something which is not always found in vessels of this type.

The forward part of the saloon deck is raised to the height of the saloon deck rail, and forms a very airy space for passengers desiring a good view, fresh air and sunshine. The space between this and the saloon proper is covered over by the hurricane deck, and is sheltered from rain and sun by a side visor. The saloon proper is a large steel enclosure, having steel paneled walls. The floor will be carpeted; desks, chairs, and a news or stationery stand will be located in this cabin for the comfort and convenience of passengers. Hardwood seats are arranged as in a Pullman car. The windows are arranged in groups of three and are built to open similarly to a house window, each window is provided with a pantasote shade sliding in grooves as on a railroad car. This saloon is surmounted by a central coach roof skylight, which affords ventilation and central light. The design and finish of this saloon are similar to the social hall, but lighter in character. The casings from the boiler room, stokehole and engine room passing through the saloon are all of steel. The space abaft the saloon is a covered promenade, lit in the center by a coach roof extension, and has a side visor fitted all round.

There are two stairways from the saloon to the hurricane deck; the after stairway is protected by an awning, while the forward stair lands in a hallway in the officers' deck house. The pilot house is raised above the level of the remainder of this deck house, and has a navigating bridge carried at the level of its floor out to the sides of the ship. The usual steering, navigating and controlling appliances are installed. Abaft of the pilot house is the hallway and rooms for officers, all of which are fitted with metal beds. The remainder of the space on this deck and on top of the coach roof, which is railed in, is devoted to a passengers' promenade; two of the lifeboats being stowed on this deck. The whole space from the house aft is covered and protected by an awning carried on a metal framework. The top of the officers' house extends to the side of the vessel and forms a shade and deck for the remainder of the lifeboats.

The rail and awning stanchions throughout these vessels are of metal. The deck machinery consists of a combined hand and steam steering engine of Williamson Bros.' make, located in the engine room and controlled from the pilot house in the usual manner. A hand capstan by the same maker is fitted forward, also an anchor crane for operating the anchor and chain. The vessel is lit by electricity generated by two General Electric direct-connected marine sets, having sufficient power to operate a powerful searchlight and the wireless telegraph system. The searchlight is placed on a platform in front of the mast and controlled from within the pilot house. The aerial for the wireless apparatus will be strung between the smoke funnel and the ensign staff aft. All wiring is in conduit, and the fixtures are of a neat design in harmony with the finish of the cabins. The vessel is heated by steam, and ice water is provided and led to drinking alcoves or fountains located where most convenient for the passengers' use.

MACHINERY.

Each vessel is fitted with two boilers of the straight through or gunboat type, 9 feet 4 inches diameter by 22 feet long, constructed for a working pressure of 180 pounds per square inch. Each boiler will contain 2,100 square feet of heating surface and 47½ square feet of grate surface.

Propulsion is by means of one set of engines of the triple-expansion, surface-condensing type, having three cylinders working upon three cranks set at angles of 120 degrees. The diameter of the cylinders are high-pressure 19 inches, intermediate 29 inches, low-pressure 44 inches, having a common stroke of 24 inches. They are designed to run at about 160 revolutions per minute in service conditions.

The cylinders are arranged with the low-pressure in the middle, and cranks are fitted with balance weights, with a view to reducing the vibration to a minimum. They are supported upon three cast iron box columns at the back, and three polished mild steel columns in front. The high and intermediate cylinders are fitted with piston valves, and the low-pressure cylinder has the ordinary double-ported slide valve. These valves are actuated by the Stephenson type link motion, all parts of which are made very heavy for the extra duty imposed by the special service in which these boats are engaged. The reversing of the engine is done by a vertical steam cylinder automatically governed by eccentric and levers on the reversing shaft.

The pistons are of cast steel, designed so that the weights will be as nearly equal as possible. The guides for the piston rods are of the bar or locomotive type, cast hollow, with water circulating through them. The connecting rods have forked upper ends, with two bearings for attachment to the crosshead. The crankpin boxes are of cast steel; these and the main bearing boxes are fitted with slabs of phosphor bronze, a type of bearing which has been successfully used by the owners of these vessels for a considerable number of years. The thrust bearing is of the ordinary horseshoe type, having five collars for going ahead and three for backing, each faced with anti-friction metal.

The propeller wheel is of the solid type of cast steel, having four blades, 8 feet 6 inches diameter; this is held on to the shaft by a steel feather and wrought iron nut.

The condenser is independent of the main engine, being circular, constructed of steel plates, and containing about 1,925 square feet of condensing surface. All the pumps are independent, the air pump being of the vertical twin-beam type, having two steam cylinders and two water cylinders. The feed pumps are in duplicate, of the vertical simplex type, each capable of supplying the boilers with water under normal conditions. The bilge pump is a horizontal duplex, having steam cylinders 4½ inches diameter, water cylinders 6 inches diameter by 6-inch stroke. The circulating pump is of the centrifugal double-suction type, having large suction to the bilges for use in case of leaks. There is also one sanitary salt-water pump of the horizontal duplex type, and a large donkey and fire pump located on the main deck connected up ready for instant service.

There is one smokestack common to the two boilers; this is fitted with an outside air casing, having large intervening space for ventilation. The stack is fitted with a steam jet of the Bloomsburg latest improved type, which is expected to add materially to the steaming capacity of the boilers.

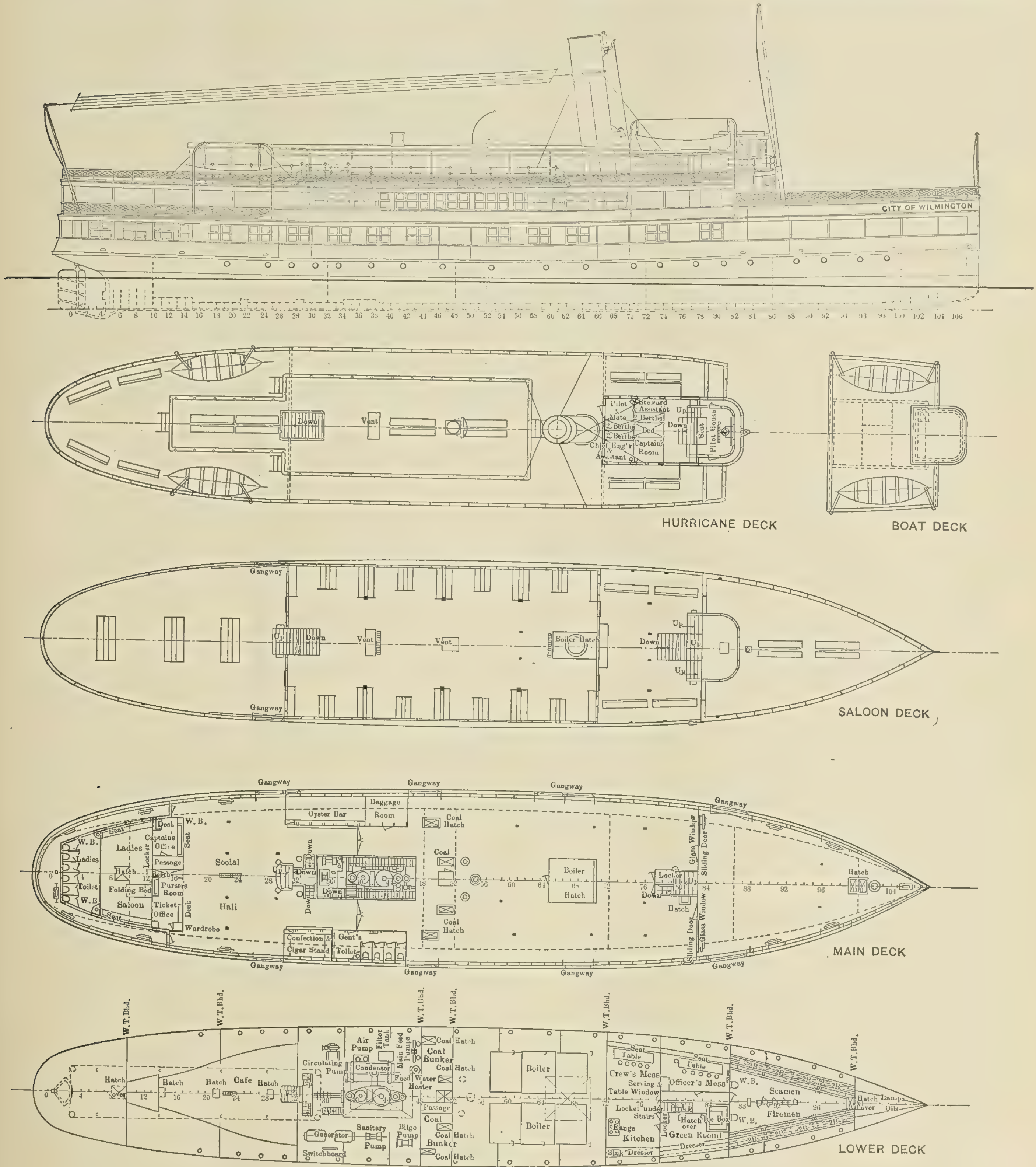
The main steam pipes, where practicable, are made of steel, the remaining part is of copper, with specially designed bends, to allow for the expansion. A feed-water heater of the multicoil type is fitted between the feed pumps and the boilers. All other details of the latest design have been installed in these vessels, so as to bring them in line with the latest practice in vessels of this class.

Trial Trip of a New Steamer.

On Feb. 15 the steamship *Bradford City*, built by Messrs. Ropner & Sons, Ltd., of Stockton-on-Tees, made her official trial trip in the Tees Bay. The steamer has been built to the order of Messrs. W. R. Smith & Son, Cardiff, and is classed to the highest class in the British Corporation Registry.

She is 358 feet 6 inches in length, and has a dead-weight carrying capacity of about 6,300 tons. Her outfit is thoroughly up to date, and includes stockless anchors, a quick-warping steam windlass, steam steering gear amidships, and powerful screw gear aft, while she is particularly well equipped with derricks and winches of the most modern type, in order to facilitate the loading and discharging of cargoes. The accommodation for the captain, officers and engineers is in houses on the bridge deck, and for the crew in the forecastle.

Propulsion is by means of triple-expansion engines, built by the North Eastern Marine Engineering Company, Ltd., Sunderland, which, it is reported, have worked very satisfactorily. After some very satisfactory trial runs, during which the vessel attained a speed of over 11 knots, she proceeded on her run round to Cardiff, her loading port.



OUTBOARD PROFILE AND DECK PLANS OF THE NEW WILSON LINERS.

MACHINERY AND PIPING ARRANGEMENTS—V.*

BY JOHN M'COLL.

As it is usually in connection with the ballast and bilge systems that the engineers can commence work on a ship, it is advisable to have this part of the work in hand, and the drawings, sketches and prints sent out to the shops as soon as possible. It will be an advantage in most cases to tint the leads of piping in the arrangement prints sent to the fitting-out department; it can be easily and quckly done in the drawing office, and will save time in the other department. The prints should be of cloth or linen, as paper, either thin or thick, will not stand the handling and wear to which it would be subjected in the ordinary course of the work. As previously stated, the drawings need not form part of or be embodied in the main drawing; they are better kept separate, especially in medium-sized and large ships. The drawings required are a plan, elevation and sections; of course the number of sections and partial views will depend upon whether the job requires minute detailing or not. If a framed print is to be supplied for the engineers of the ship, this should be considered when grouping the different views, so that they may be contained within reasonable limits. The scale to which the drawings are made for small vessels is usually ½ inch to the foot, and for the larger ships ¼ inch to the foot.

The pipes and fittings for the ballast and bilge steam service extend the whole length of the ship, except in the fore peak, which is fitted with a hand-pump suction only, and an agreement generally must be made between the shipbuilders and engineers regarding the share of the work each will do. The usual demarcation is, that the engineers do all pipes and fittings inside the forward and the aft bulkheads of the machinery space, including the thrust recess and tunnel, if that is used as part of the engine room, and the shipbuilders do all pipes, etc., outside of and up to these bulkheads, supplying and fitting also all hand pumps as required on deck.

The number, size and position of the bilge steam suctions in a ship will depend on the rules issued by the society with which the ship is classed, as Lloyd's, British Corporation, etc. The deck hand-pump suctions are fitted according to the Board of Trade rules in Great Britain. These suctions are to be considered in size and number as the minimum, and may with advantage be increased. This is sometimes done, especially in the machinery space, where the owners may think it advisable to add to the number of connections, on account of obstructions to the easy draining of the bilge water, to the point where the suction pipes are located.

Generally the suctions are placed at the after end of the compartments from which they draw, but in a ship with fine after-body, they may be better placed at the forward end of the compartment in that part of the ship. In other words, they should be placed at a point to which the water will probably drain. In vessels where the tanks are carried flat to the ship's side, or in recesses and passages where the water cannot escape to the ship's side, depressions or shallow wells are made in the tank top. These are made sufficiently deep for the water to collect there and insure the pumps drawing properly.

The usual procedure followed in connection with ballast and bilge arrangements is, that the shipbuilders make out in diagram form the arrangement for the whole ship, getting from the engineers their proposals for the machinery space. This is sent for approval to the surveyor of the society with which the ship is registered, and in every case to the Board of Trade for their approval. The shipbuilders may send only their part early for approval, leaving the engineers to submit theirs separately, when finally arranged.

An important point to be considered in fixing the position of bilge suctions, is that the rose boxes should be readily accessible for cleaning. Some ships with double bottoms, all fore and aft, do not carry water ballast in that part under the boilers, but one or more bilge suctions will be required there, and these should be placed so that they can be easily reached from the nearest tank top manhole. The same consideration ought to be given to placing the ballast tank suctions. One or two frame spaces forward or aft will make little or no difference in the efficient pumping out of the tank, while it may save the ship's engineers from having to get through a maze of holes in floors, under conditions which are very different from those obtaining when the ship is in dock.

It may be stated that all ballast tank valves are made to lift with the spindle, and all bilge valves are of the non-return type. All bilge suction pipes have rose boxes fitted at their ends, but with tank suctions these are not required. Each bilge suction should be provided with a mud box in addition to the rose box, and the water should pass through the mud box before going through the valve. This arrangement will admit of the mud box being cleaned out while the other suctions are being used. The pipe from the box should, if possible, be straight, as shown in Fig. 20, so that it would be easy to clear if it became stopped. All these requirements can seldom be allowed for together in the same job, and, as in arrangement work generally, compromises very often have to be made.

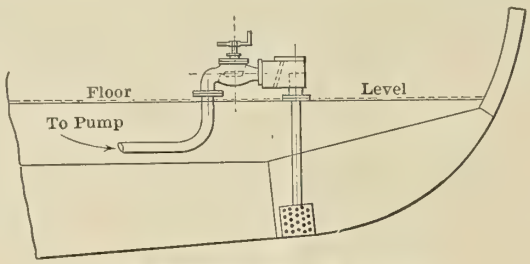


FIG. 20.—BILGE VALVE AND MUDBOX.

The position of the valve chests or groups of valves in the stokehold and engine room will naturally depend on such things as the position of bunker doors, bulkhead stiffeners, ladders, wide or narrow passages or stokeholds, and the height of the platform. In the engine room there is seldom much room for choice, and the guiding requirement might be stated as, that both ballast and bilge-valve chests should be placed where they can easily be reached for working—the bilge boxes especially for cleaning—and all where the length of piping for connecting up will be the shortest.

With regard to the number of valves that may be grouped in one ballast chest there is no definite rule. It is often better to have two or three small independent chests placed near their work than one large chest with the pipes stretching across the tank and crowding together at the valves. It may be better economically, and, what is more important, it will lessen the risk of failure of the whole system if one valve or chest should require overhauling.

The form of valve most common is the ordinary miter-faced type, with brass seat. Another type used consists mainly of a rubber disk, suitably held on the spindle. The latter has some advantages, but does not wear very well. Tell-tale pipes to indicate when each tank is full are sometimes fitted to the chest. These are small wrought-iron pipes about 1 inch bore, screwed into a boss below each valve and carried up the side of the bulkhead to a little below the level of the light load line.

* Concluded from the February issue.

The size of the outlet branch from a chest, with two or more valves, need not be greater than that of the largest suction, and if suitable the branch should be turned down in line with the inlet branches. The height of the chest from the tank top should not be more than will give room for easy bends in the pipes to and from it (as the more nearly the pipes are kept in one plane, the less the work that is put on the pump), but for convenience they are usually arranged with the lower pipe flange in line with the platform. In the stokehold the valve chest should be well guarded round with fender plates, so as to keep them from injury and dirt. In special cases these fender boxes are fitted with padlocks and so subdivided that each wheel is under the control of the engineers only.

In ships with deep ballast tanks special arrangements have to be made. Unlike the ordinary ballast tanks, they cannot be filled by simply letting the water run in; they require to have the water pumped in after the outside water level is reached. This pumping up should be done through a separate discharge pipe from the ballast pump direct to the tank. If it is done through the main system pipes, these are subjected to undue pressure, which may result in leaks or breakage. These tanks are used as ordinary cargo holds when possible; and as there is the possibility of water getting through to the cargo when filling the other tanks, extra precautions are taken to prevent this. A simple device is that shown in Fig. 21.

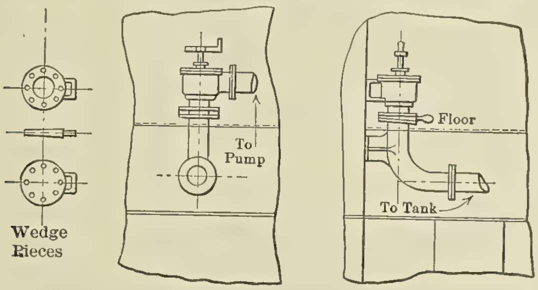


FIG. 21.—ISOLATING ARRANGEMENT FOR DEEP TANKS.

Here wedge-shaped pieces are made to fit between the chest and a cast-iron bend or pipe. One piece is made as a ring, and fitted when the tank is used as a ballast tank, to be taken out and replaced by a blank wedge piece when the tank is used as a cargo hold. The piece not in use is either stowed immediately above the chest or kept in the engineer's room.

The suctions from the deep tank should be as large as possible; that is as large as the main pipe, and if the tank extends the full width of the ship, a small suction should be fitted at each side so that it may be well drained. These suctions should also have the wedge pieces or other isolating arrangement. With regard to the pipes and fittings for deep tanks, it should be remembered that the extra head of water will put extra pressure on these, and it may be necessary to make allowance for this accordingly.

The diameter of the ballast main pipe will depend much on the time to be allowed for filling and emptying the tanks. The capacity of the ballast pump will probably be based on that requirement, so that the bore of the suction opening on the pump may be taken as approximately the bore of the main pipe. In some ships having to sail for part of their voyage in shallow waters the tanks may be required to be emptied at very short notice, then advantage is taken of the full capacity of the pump. In other ships, where more time can be taken, one tank at a time is filled or emptied; in that case the combined areas of the suctions from the largest tank may be taken as the area of the main pipe.

Suction pipes on their way to the valve boxes should not pass through other tanks, as in the event of pipes becoming leaky or damaged, it is not easy to decide which tank is being drawn from, or filled, or to locate where the defect lies. Various difficulties may be caused through the pipes being arranged that way, and in most cases it is better to have the pipes carried along the tank top or at the ship's side. The length of cast iron pipes in the ballast system should not exceed 9 feet, and long runs of these should not be bolted together without introducing at some part bends of flexible material. Lead is the material most commonly used for bends, and it is suitable up to 6 inches bore, above that it is advisable to use copper. In first-class work galvanized iron is used for bends, and it certainly is better in many respects than lead for that purpose.

The suction pipes projecting into the tanks are carried down to within a quarter of the diameter of the pipe from the bottom of the tank. Some of these pipes of large diameter are made bell-shaped at the end, and may be carried still closer to the tank bottom, provided the area past the edge is equal to the area of the pipe.

If the sea inlet valve for the ballast tank is to be used for that purpose only, it will be at least the same diameter as the main; but if it is to serve also as the sea suction valve for the ballast pump, it may require to be made larger than the main. The suction connections of the ballast pump are usually from the sea, ballast tanks, bilge system and bilge direct. These are sometimes grouped in one box and bolted to the pump. The point to be observed in this arrangement is, that when the tanks are being run up, the water should not cover the bilge valves, as otherwise the pump has to stand idle till the tanks are filled. The box can easily be made to suit this requirement and should be so made if at all convenient.

The ballast pump suction from the bilge direct should be larger than the ordinary bilge suctions, and in large ships it may be advisable to fit one at each side of the engine room.

When there are two or more pumps drawing from the bilge system, it is good policy to divide the system into two sections—forward and aft—by fitting a straight through cock in the main. An equal number of pumps are put on each section, and each can draw from any part of the system when the cock is open, but should any section, say the forward one, be disabled, the cock is shut and the after section is not affected, or, of course, the aft division may be damaged without involving the forward part.

The arrangement and details of the ballast system piping will apply generally to those for the bilge system, and the thickness of the cast iron, and wrought iron, or weight of the lead pipes will conform to the owners' requirements, or to the builder's standard practice.

SCHOOLS OF MARINE ENGINEERING AND NAVIGATION IN CONTINENTAL EUROPE.

BY W. H. DOOLEY.*

Very few people realize how far behind other countries the United States is in her facilities for the education of marine engineers and navigators. In this country we believe in educating at public expense young men who are going into the professions, but nothing is done towards helping the young tradesman to advance in his craft. This is particularly true in the marine branches.

No country spends the amount of money for marine education that the little country of Holland has seen fit to do. Of course, Holland is distinctly a commercial country. Her numerous ports and excellent docks place her among the leading commercial nations of the world. The chambers of commerce of her cities are "live" bodies and are constantly bring-

* Principal Lawrence (Mass.) Industrial School.

ing before the world the advantages of Holland as a commercial nation.

As early as 1878 the progressive shipowners of Holland established a school for educating engineers exclusively for sea duty. This was established in Amsterdam and was built to meet a distinct educational need in the marine service, to insure proper training for engineers. The school has long since proved its worth. Since this school has been founded there has been less damage, due to incompetent engineers.

Similar in aim to the training school for marine engineers is the old school, renowned in the Netherlands, and known as the training school for the merchant marine. The aim of this school is to train officers for the Dutch marine. Not all boys with an inclination for sea duty are able to avail themselves of the expensive training supplied by the marine service school. For such as are unable, a cheaper course is provided in the nautical school. There are altogether eleven of these schools, and three schools for fishery, with sixty-three teachers and 590 pupils. With the exception of the oldest school at Amsterdam, they are supported by State, provincial and municipal subsidies, and by private donations. Some of these schools are free, others charge a very small fee.

Examinations for masters' and mates' certificates, similar to those of the Board of Trade in England, are held ten times a year alternately at Amsterdam and Rotterdam by a commission appointed by the Ministry of Waterways, Trade and Commerce; candidates must be eighteen years of age, and in addition to the technical subjects, they are examined in English, French and German.

The school at Rotterdam is next door to the Seaman's Home in the Westhaven, and the director, E. J. Hoos, is always happy to show one through. Lads, in order to enter, must not be less than fourteen or more than seventeen years of age on entering. The practical instruction during the first year is given chiefly by an old boatswain. The garden has a rigged mast with yards and sails, and a boat for rowing, etc. Later, the instruction is given by a former captain in the merchant service. The classes in steam engineering and the construction of ships, etc., are taken by a retired naval officer, who was at one time instructor at the Royal Naval Institute. An ample supply of good models and drawings has been provided by the manufacturers, and there is an engine from one of the demolished torpedo boats. Pupils have full access to the engine and shipbuilding wharves, the drydocks, and can go on board the mail steamers. From time to time they are taught how to handle engines on boats going down to the Hook. The number of pupils in the two years' course is fourteen, and of those in the special classes, ninety-nine, the average attendance of the latter being about thirty-three a month.

Since the opening of the fisher's harbor at Ymuiden in 1896, that port has been the principal fishing center of the Continent. In the year 1908 over $2,000,000 (£410,700) worth of fish was sold in the fish market of the town. This was largely exported in daily shipments to foreign countries by rail in a fresh state. In view of the importance of this industry a school was started in 1906 at Ymuiden with the idea of obtaining in the future a staff of thoroughly trained captains and mates for sailing and steam fishing boats. Although the school has been in operation for only two years and a half, the results obtained are very satisfactory.

Every Dutch boy who has passed successfully the physical examination and can show a report of good character from the public school which he attended can obtain permission to enter the school, which is divided into three classes.

The first class, the work of which covers a period of one year, starts in November, and is for boys just leaving school, between thirteen and sixteen years of age, who are taught arithmetic, geometry, the Dutch and English languages, shipbuilding, geography, practical and theoretical navigation, laws of navigation, steam mechanics, refitting of vessels, first aid in case of accidents, making and repairing sails, nets, etc. The theoretical work is done on shore in the schoolroom; the practical part on board the instruction vessel in the fishing harbor of Ymuiden, and on board a sailing vessel called the *Ymuiden*, which puts out to sea from February to October.

From November until February the boys remain on shore; afterwards they are sent to sea in the fishing vessel, five boys at a time, for eight days, and so on till October. During their stay in the harbor the boys sleep on board the instruction vessel, so that they may become accustomed to life on board ship. This instruction vessel is fitted out for ten boys, and is under the supervision of a captain and his wife; the captain gives practical lessons in repairing, refitting, etc. The boys have 40 hours class work a week, of which 14 hours are practical work. After the first year they can obtain a certificate from the board of directors, who find employment for them on board sailing vessels, so that they can learn fishing thoroughly and earn their own living. Their wages are about $10 (£2.05) per month. The board provides each boy with a whaling suit of cloth, shoes, etc., on entering the school, but the boys are obliged later to refund the money out of their own earnings, from which 20 percent is deducted and paid direct by the captain of the vessel on which the boy is serving to the board of directors. The cost of such an outfit is about $24 (£4.9) a boy.

After having spent three or four years at sea, the boys return to the school to prepare in the second class for the government examination for the certificate of mate of fishing vessels, which preparation occupies almost five months. After another year at sea they return for the last course of three months in the third class, which prepares them for the government examination to obtain their certificate of captain, so that in six years the whole course can be completed. In the last two classes they work 22 hours a week.

For the first course no fee is paid, but for the last two courses pupils have to pay $1 (£.02). If a pupil is not considered diligent, or if he goes to sea before having obtained a certificate from the board after the first year, he is immediately dismissed, and his parents or relatives are compelled to refund the money paid for his outfit. The society was started by voluntary contributions, and the government lent the two training vessels. In several other parts there are similar schools, but this is the only one in which lessons are given the whole year round. At the end of the first year twelve certificates were given to the pupils, for whom employment was found on the different fishing boats and trawlers of Ymuiden. The reports from the captains of these boats concerning the work of the pupils are satisfactory up to the present.

The Prussian government turned its attention to the establishment of schools of navigation as early as the beginning of the nineteenth century. One of the first of these schools is reported to have been organized at Danzig in 1817. The purpose of this institution was declared to be the education of competent sailors, pilots and captains. In the absence of an independent school building, and of sufficient funds to erect one, the new school had to content itself, for the time being, with four rooms of an old church. The course of study occupied two years and was eminently practical. In fact, in all its essentials the curriculum remains the same to-day.

In the course of the decades following the establishment of the school at Danzig, a number of similar institutions were founded elsewhere. By 1855 such schools had been organized at Memel, Pillaw, Gralow and Stralsund. The attendance at this time was 246, and by 1863 the number had been swelled to 304. More schools were soon added, for their value was

proved by the results of the old schools. In close succession there followed schools at Barth in 1865, and at Leer in 1866, and at Geestemünde in 1870.

It was deemed highly important to provide means whereby the young boy might start as early as possible the study of his profession, as it was claimed to be necessary to enter the seaman's profession at an early age, even at a sacrifice of part of the general education that might otherwise be obtained. For this reason preparatory schools were organized in connection with all the regular schools of navigation, while in some cases special preparatory schools were established independently. Experience has shown that many of the students who attend the preparatory schools drop out on completing the work without entering the regular schools. Among these are numbered students who are too poor to afford a higher education, as well as those who, from the start, are undecided as to just what profession they will enter.

The popularity and value of the schools of navigation are well shown by their wide distribution throughout Prussia. In 1902 institutions of this class were located at Pillaw, Danzig, Gralow, Stralsund, Barth, Altma, Flensburg, Apenrade, Geestemünde, Timmel, Leer and Papenburg. Each of these schools has a preparatory school connected with it, and similar preparatory schools have been established independently at Sunidemark and six other places.

The total attendance at the preparatory schools, including the independent ones and those associated with regular schools, was 828 in 1901. During the same year 472 pupils were enrolled at the regular schools, of whom 323 studied as pilots, and 39 as captains.

For admission into the schools of navigation the applicant must show familiarity with the German language; knowledge of the fundamentals of fractions, decimals, proportion, extraction of roots; knowledge of algebra and geometry, especially of triangles and circles; knowledge of the elements of political and nautical geography. The possession of these educational requirements is tested by an entrance examination.

The two years' course of study in schools of navigation includes the following branches: Arithmetic, plane geometry, stereometry, plane trigonometry, spherical trigonometry, mathematical geography, astronomy, drawing; description and use of logarithms, half-minute glasses, compasses, use of Mercator's charts; calculation of currents in the sea; calculation of time on board; calculations of distance; hydraulics; statics, wind, sails, and their manipulations, maneuvering and control of ships; shipbuilding; duties and obligations of captain to his men and his cargo, and in loading, clearing, and sailing, quarantine, stranding, salvage, etc. It is hardly necessary to call particular attention to the eminently practical character of this series of studies in preparing a boy for a career on the sea.

No examination is required for admission into the preparatory schools, and the curriculum with the hours of study per week is as follows: German 6, arithmetic 12, geometry 8, geography 4, drawing 2. This gives a total of 34 hours per week. In addition, 2 hours a week are generally devoted to a study of first aid to the injured, under the guidance of a man with a professional medical training.

In 1879 the German Emperor by special ordinance prescribed regulations for the holding of examinations for those who desired to enter the profession of naval engineer. While these regulations were not severe, but merely required the knowledge to insure competent service, it was found that the applicants as a body were utterly unqualified for the work. They came largely from the locksmith and fireman's trades, and proved poor recruits for the rapidly developing navy and merchant marine of the Empire.

The result was that two schools for naval engineering were established, one at Flensburg and one at Stettin in 1890. At Flensburg, naval machinists from the first to the fourth class were educated, and at Stettin only those from the second to the fourth class. The Flensburg school, therefore, offered the higher grade of instruction.

The work for machinists of the fourth, that is, of the lowest rank, involves the following studies: German, arithmetic, mechanical engineering, physics and technology. A total of 24 hours a week are devoted to these studies for the period of two months. Machinists of the third class study German, arithmetic, mechanical engineering, physics, technology and electrotechnics. The latter branch characterizes the third class. A total of 30 hours a week is devoted to these studies for a period of two months. Machinists of the second class study mechanical engineering, drawing, mechanics, physics, technology, electrotechnics, arithmetic, geometry, German and English. A total of 45 hours a week for a period of five months is devoted to these studies. The studies for the first class machinists are German, English, plane geometry, stereometry, arithmetic, trigonometry, mechanics, physics, chemistry, mechanical engineering and drawing. Forty-five hours a week are devoted to these branches for a period of five months.

A SMALL OFF-SHORE CRUISER.

BY STEPHEN P. M. TASKER.

The boat illustrated is a useful and sea-worthy 31-foot cruiser, suitable for bay and off-shore work. Motor boats of this free-board and construction, with a reliable engine and good ground and sea tackle, are almost unsinkable. They can keep at sea for three or four days at a time and offer fairly comfortable living accommodations for three.

There is 6-foot head room throughout, with suitable cooking and sanitary conveniences, with speed commensurate with low cost of operation, vibration, etc. The cost of such a boat, with a high-grade motor, varies from $1,000 (£206), where one builds the hull himself, to $2,000 (£412) when furnished by a builder.

The lines are fairly good for the designed speed, considering suitable buoyancy, and with a maximum amount of interior space for the length.

Commencing forward, there is a galvanized iron fresh-water tank containing about sixty-four gallons, built to suit the shape of the boat. The tank is contained in a watertight compartment. In a 12-inch locker on the aft side of the bulkhead there are shelves, hooks, etc., with a door opening from the owner's cabin. In this locker there is placed an oak towing bit embeded in the oak stem. The owner's cabin contains two 6-foot 6-inch berths, with large drawer and locker space under, two side lights and several shelves. This cabin contains full head room, excepting at the forward end, and is well ventilated by a 6-inch ventilator, with copper cowl placed well forward, and a 2-foot skylight in the after end, thus affording good air circulation.

Aft of the cabin, on the port side, there is a heavily insulated icebox with dresser over, furnished with a galvanized iron sink, piped for fresh water from the forward tank. A two-burner yacht stove is supplied. A swinging shelf affords the necessary space for the preparation of meals. Above are the necessary dish racks, etc. Aft of the icebox is a 6-foot transom berth, with locker space under. On the starboard side forward is a 3-foot by 3-foot toilet, with patent water closet and wash basin. Aft of this compartment, by swinging up the companionway steps, the space can be utilized as a berth, with lockers under, making four berths in all. This compartment contains four side lights, a 6-inch ventilator

forward, a 3-foot skylight, two 12-inch by 14-inch windows, and a large companionway, affording ample ventilation. The trouble with most small cruisers is, that they are invariably very warm. No matter how well insulated the engine is, there is bound to be an accumulation of heat, and under a hot sun the boat becomes very stuffy. This is practically eliminated by the large amount of ventilation shown on these plans.

Another objection to the small boat is the vibration and noise of the high-speed motors usually installed. The motor most suited to these models is a heavy-duty slow-speed gasoline (petrol) or kerosene (paraffin) motor. The one shown in the plans is a 12 or 16-horsepower, heavy-duty, slow-speed, two-cylinder, four-cycle motor, of 6-inch bore and 7½-inch stroke, weighing, with reverse gear, 1,320 pounds. The horsepower from tests shows:

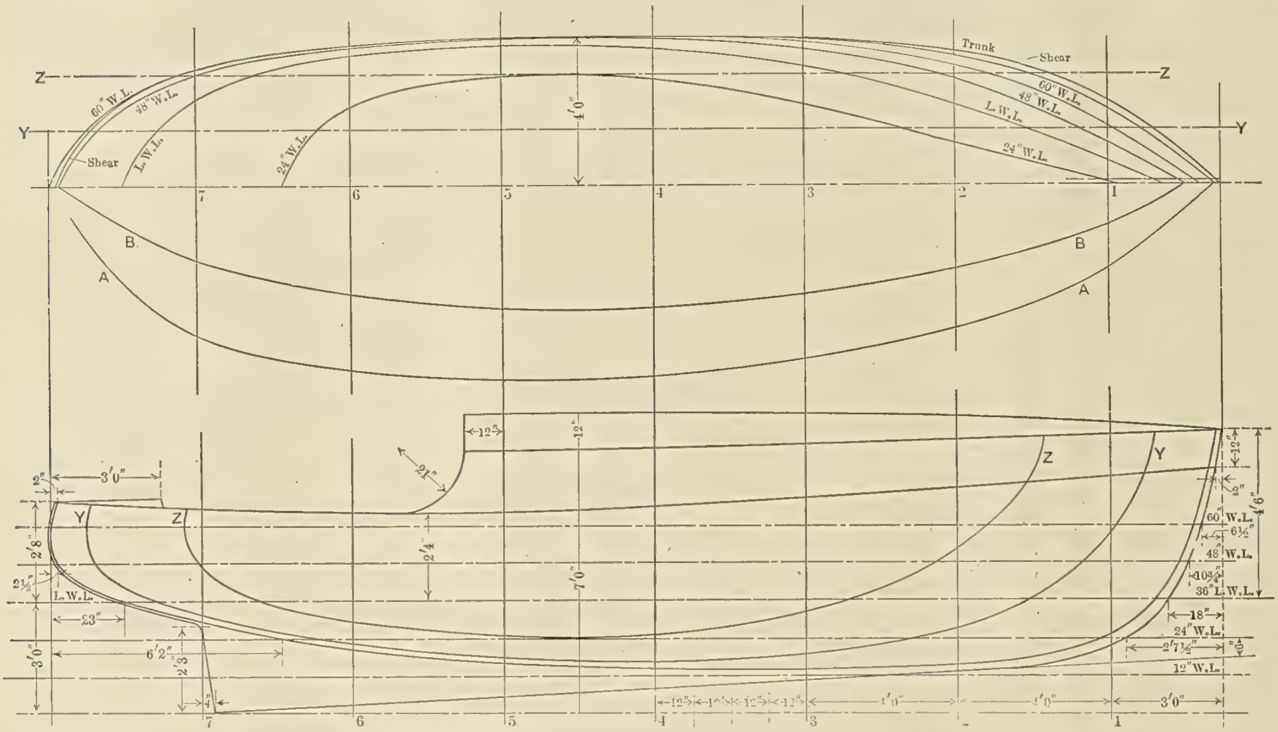
At 250 R. P. M.	12.61
At 300 R. P. M.	14.75
At 350 R. P. M.	16.66
At 400 R. P. M.	17.61

Consideration should be given the clutch on marine motors, as they have been a considerable source of trouble, and instead of the old-fashioned sliding key and expanding wedge for operating the wings of the clutch, there should be two arms riding up on a bobbin with all adjustment made from the outside. The gears for the reverse gear action should be made of the highest grade steel, bronze bushed. The spur gears are always in mesh and only in action on the reverse. The reverse band should be lined with Babbitt (giving an easy gripping action) and tightened by a worm screw.

Aft of the engine compartment there is a watertight cockpit, with large storage capacity underneath. The deck house is carried two frame spaces aft over the engine, to give plenty of head room and to facilitate overhaul. On the port side of the cockpit and in the recess made by this continuation of the deck house is the throttle lever, spark control, reverse lever and steering wheel. From this position the motor is visible, and the boat can be easily handled by one man.

The cockpit contains comfortable seating capacity for the crew, with open or closed storage space under the seats. Aft of the cockpit is the fuel tank containing fifty-seven gallons of gasoline. Emergency gasoline tanks can be carried under the cockpit seats if they are desired.

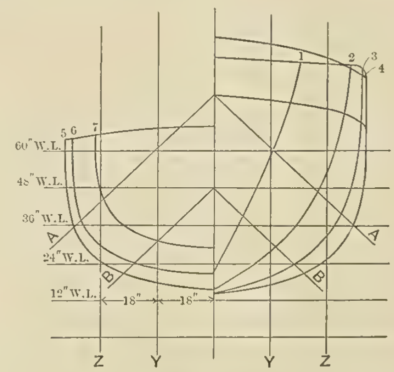
For certain conditions and waters it is preferable to use



WATER LINES, DIAGONALS AND BUTTOCKS OF A SMALL OFF-SHORE CRUISER.

The normal speed is 350 revolutions per minute and the minimum 100 revolutions per minute. The diameter of the crankshaft is 2¼ inches, and of the bronze propeller shaft 1½ inches. The propeller is a three-bladed manganese bronze wheel of 24-inch diameter and 30-inch pitch, the area is 209 square inches. The diameter of the exhaust pipe, which is water cooled, is 2 inches. The muffler is well insulated and is stowed under the cockpit. The ignition system is "make-and-break," with Bosch magneto, and is gear-driven, thus doing away with the unreliable dry cells. The motor is oiled by a mechanical force-feed lubricator, with ring oilers for the connecting rods, the same as government practice.

The circulating water inlet is 1-inch diameter, gasoline pipe ⅜ inch I. P. S. The air and circulating water pumps are the plunger pattern, and with a three-way sea cock attached, the bilges can be pumped out. The Schebler carburetor and the usual fittings and attachments consistent with the latest practice in gasoline (petrol) motor construction are furnished. The stuffing box and out-board bearings are of bronze, lined with Parson's white metal.



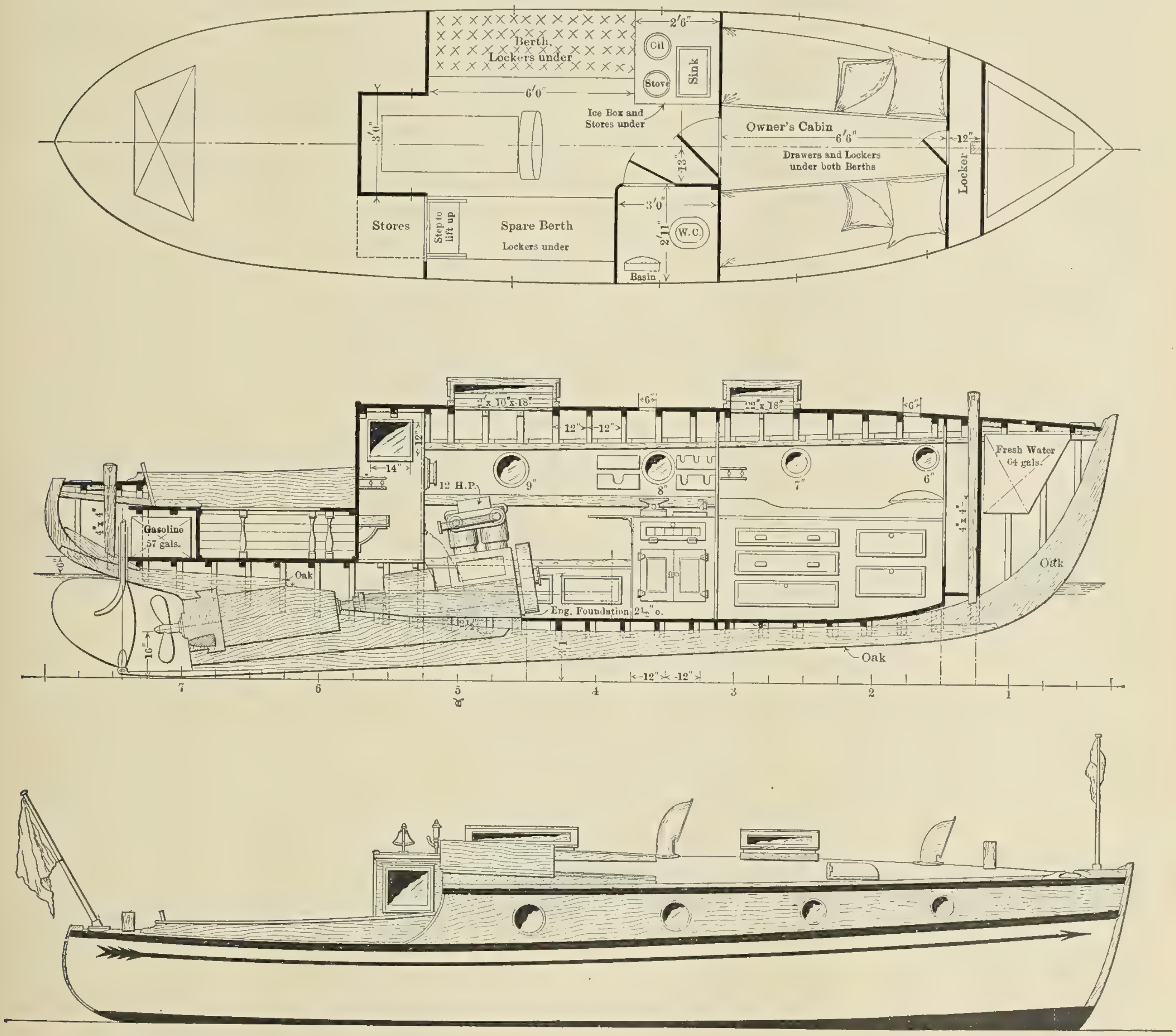
BODY PLAN.

kerosene (paraffin) in place of gasoline (petrol) for fuel. It can be procured where gasoline cannot and is considerably cheaper and theoretically more efficient. As it is a heavier fuel than gasoline it does not vaporize as readily. It is necessary to thoroughly vaporize it to secure proper combustion, and to prevent rapid fouling of valves, cylinders, piston rings, etc.; to do this the fuel must be heated. To accomplish this it is necessary to have a special casting, the inlet and exhaust manifolds being cast integral, the hot exhaust passing around inlet manifold, rendering vaporization complete. Sooting up of the interior of the inlet manifold, valve chambers, etc., is guarded against by special appliances in inlet manifold. The regular float-feed carburetor is used in making the mixture. It is, of course, necessary to heat the inlet manifold before starting on kerosene. This is accomplished by starting on gasoline and running for a few minutes, then switching over to kerosene. Only a small quantity of gasoline need be carried, and piping should be arranged with a three-way valve, so that one movement shuts off gasoline and turns on kerosene. This device has been thoroughly tried out in actual service, and a large number of working boats are now so equipped. As kerosene is a heavier fuel, the compression in a kerosene engine must necessarily be lower than that in a regular gasoline engine.

It is advisable to connect by belt or friction to the fly-wheel a small dynamo, with a 60-ampere hour storage battery for illumination purposes. There is enough energy generated during the operation of the engine to run the lights at night with the motor stopped, thus doing away with the danger of oil and matches.

For salt water the boat should be equipped with a bronze shoe and rudder.

This boat was designed by Tasker & Strawbridge, engineers and naval architects, Philadelphia, Pa.



GENERAL ARRANGEMENT OF SMALL OFF-SHORE CRUISER.

Trial Trip of the S. S. Benbrook.

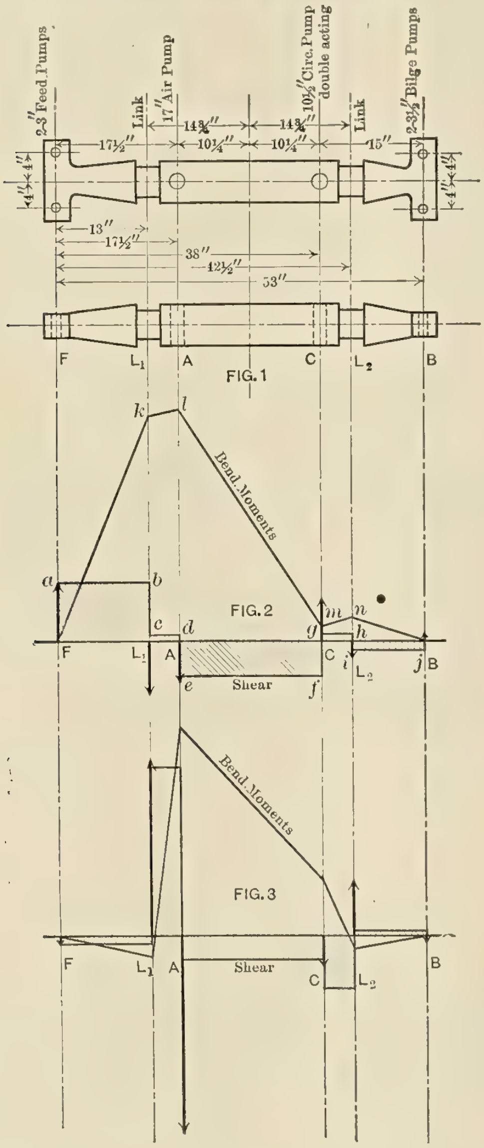
On Wednesday, Feb. 16, the finely modeled steel screw steamer *Benbrook*, built by Messrs. Craig, Taylor & Co., Ltd., Stockton-on-Tees, to the order of Joseph Hoult, Esq., of Liverpool, underwent her trial trip, which proved highly satisfactory in every way. The steamer will carry about 7,000 tons dead weight on a light draft of water, and the engines, which have been constructed by the North Eastern Marine Engineering Company, Ltd., Sunderland, gave her a speed of 10 knots loaded. On Feb. 24 the same firm launched the *Bengrove*, a sister ship of the *Benbrook*.

CALCULATIONS FOR THE SIZE OF A PUMP BEAM.

BY EDWARD M. BRAGG, S. B.

The stresses in the pump beam shown in Fig. 1 should be calculated for the worst condition, and in order that we may know the worst condition we must consider the action of the different pumps.

The total head upon any one of the pumps will be the resultant of the weight and inertia of the pump parts and water, friction, and the head, against which the pump is acting. Only that part of the water which is in the pump barrel need be considered when an air chamber is attached.



STRESS DIAGRAMS FOR PUMP BEAM.

The inertia is greatest at the beginning of the stroke, and upon the assumption of harmonic motion will be: $I = .00002837\ W\ r\ u^2$.

W = weight of plunger or piston, pump rod, and water in the cylinder. r is half the stroke of the pump in inches. u is the number of double strokes of pump per minute.

The friction F is not easy to determine, as it depends upon how hard the glands have been set up.

The head H against which the pumps are working will depend upon the suction head, discharge head, and the frictional loss in the pipes and valves.

In the case of the two 3-inch feed pumps, the weight and inertia of the parts will be small, compared with the head against which the pumps are working. The frictional resistance may be large, as the gland is fitted around the plunger and not around the rod. The up stroke is usually the suction stroke, and the water always comes to the pump under pressure and so does not have to be lifted. The maximum load on the pump rods will come at the beginning of the down-stroke and will equal $F + I + H - W$. The feed pumps usually have a relief valve attached to them to prevent the pressure in the feed line from becoming excessive when the supply pumped is in excess of the demand at the boilers. This relief valve is usually set at a pressure of about 20 pounds above the boiler pressure. The additional resistance, due to friction, inertia, and weight will probably be covered by an allowance of 20 pounds per square inch. This makes the total load upon the feed pumps $F + I + H - W = (180 + 20 + 20)\ 2\ \pi\ (1.5)^2 = 3{,}100$ pounds, approximately.

The load upon the bilge pumps will be comparatively small, and while they have to work against the suction head upon the up stroke, that will be small compared with the discharge head upon the down stroke. The discharge head will be approximately equal to the draft of the ship, and a sufficient allowance will be made for the other resistances if we take the total load as that due to twice this head. In this case we will assume the total head as 50 feet, and the load upon the two 3.5-inch bilge pumps will be $(50 \div 2.25)\ 2\ \pi\ (1.75)^2 = 425$ pounds, approximately.

The double-acting circulating pump will work against the greatest load at the beginning of the up stroke. This pump would have the least work to do when the ship is fully loaded, so that the overboard discharge from the condenser is but a foot or two above the waterline. If the pump suction is arranged to pump from the bilge in case of accident, this will be the condition for maximum load. The load at the beginning of the down stroke will be estimated, as that is the time when the other pumps have the most work to do, and the load for this pump will differ from the maximum only by the weight of the pump and the water in the cylinder. We will assume the total lift to be 25 feet; friction head of water to be 10 feet; inertia of pump and water to be equivalent to a pressure of 10 pounds per square inch; weight to be equal to 2 pounds per square inch, and friction of piston equivalent to 3 pounds per square inch of pump area. Total load $= [(25 + 10) \div 2.25 + 10 + 3 - 2]\ \pi\ (5.25)^2 = 2{,}300$ pounds, approximately.

As the air pump is single acting, it will always exert a downward pull upon the beam, except for a brief space of time towards the end of the down stroke, when the impact of the bucket on the water under it will cause an upward pressure. At the beginning of the up stroke the load will be due to the weight and inertia of the pump parts and water on the bucket and the friction. The pressure on the top and bottom of the bucket will be the same, and equal to the vacuum at that point. As the bucket rises, the pressure on the top increases and the load is probably a maximum when the water on the bucket strikes the underside of the discharge valve. At the beginning of the down stroke the load will be the resultant of the downward pressure, due to the vacuum of about 14 pounds, minus the inertia, equivalent to about 3 pounds per square inch; minus the friction, equal to about 3 pounds per square inch; plus the weight, equal to about 2 pounds per square inch of bucket area. The load will then be $(14 - 3 - 3 + 2)\ \pi\ (8.5)^2 = 2{,}270$ pounds, approximately.

In a case like this it is best to proceed as indicated by Fig. 2, where we have represented by heavy lines the loads just found for the different pumps. The distances between the pump rods are laid off to any convenient scale, and lines are drawn at these points, the direction of any line indicates

the direction of action of the load, and the length of the line is proportional to the amount of the load. The feed pumps are attached at F, the air pump at A, the circulating pump at C, and the bilge pumps at B. The links driving the beam are attached at L_1 and L_2, and the forces that these links exert must be such that their sum is equal to the total load from the pumps, and the moment of the resultant of the link forces is equal to the moment of the resultant of the pump forces about any chosen point of reference. In Fig. 2 we will take F as our reference point and find the resultant moment:

Pump.	Load, Pounds.	Arm, Inches.	Moment, Inch Pounds.
F........	3,100	0.	0.
A........	— 2,270	17.5	— 39,725
C........	2,300	38.	87,400
B........	425	53.	22,525
Total ...	3,555		70,200

L_1 is 13 inches from our point of reference, and L_2 is 42.5 inches.

$$\therefore L_1 + L_2 = -3{,}555, \text{ and } 13\,L_1 + 42.5\,L_2 = -70{,}200$$
$$13\,L_1 + 13.\ \ L_2 = -46{,}215$$
$$0 \quad + 29.5\,L_2 = -23{,}985$$
$$L_2 = -\ \ 813$$
$$L_1 = -\ \ 2{,}742$$

The shear on that part of the beam between F and L_1 will be 3,100 pounds. At L_1 the downward force of 2,742 pounds will reduce this shear to 358 pounds, which will be the shear on the beam from L_1 to A. At A the downward force of 2,270 pounds will cause the shear from A to C to be 1,912 pounds. At C the upward force of 2,300 pounds will cause a shear of 388 pounds on the part of the beam between C and L_2. Here the downward force of 813 pounds will give a shear of 425 pounds on the beam from L_2 to B.

The bending moment at any point will be the sum of the shearing forces between the end of the beam and that point. Starting from F the bending moment at L_1 will be

$$+3{,}100 \times 13 = +40{,}300 \text{ foot-pounds.}$$

At A the bending moment will be

$$40{,}300 + 358 \times 4.5 = 41{,}910 \text{ foot-pounds.}$$

At C the bending moment will be

$$41{,}910 + (-1{,}912 \times 20.5) = 2{,}714 \text{ foot-pounds.}$$

At L_2 the bending moment will be

$$2{,}714 + 388 \times 4.5 = 4{,}460 \text{ foot-pounds.}$$

At B the bending moment will be

$$4{,}460 + (-425 \times 10.5) = -2 \text{ foot-pounds.}$$

The bending moment at B should be 0, of course, and fails to be so here, because in getting the forces L_1 and L_2 we took the values to the nearest whole number instead of to the nearest tenth or hundredth.

The curve F, a, b, c, d, e, f, g, h, i, j B is the shearing force curve, and the summation of this curve gives the bending moment curve F, k, l, m, n, B.

Before settling upon the sizes of the different parts of the rod from this curve of bending moments, it is advisable to see if the bending moment at some part may not be greater at some other point in the stroke.

The maximum stress will come upon the air-pump rod towards the end of the up stroke when the water on the top of the bucket strikes the under side of the delivery valves. We will assume that the pump rods for the air pump and circulating pump will be of the same size for the sake of convenience in carrying spares, and that at the middle they are 2½ inches diameter, and over the threads at the end are 2 inches in diameter. With a factor of safety of 13 for this size bolt, the working load could be 10,500 pounds. We will assume that in some way this load might come upon the air-pump rod and the loads on the other rods be the normal ones for that portion of the stroke. The feed pumps at this time will be drawing in water, and their load will be mainly that due to friction and weight. We will assume this resistance to be equal to 20 pounds per square inch. The load will then be $20 \times 2\,\pi\,(1.5)^2 = 280$ pounds, approximately.

The load upon the bilge pumps will be less than what we assumed before, because they are also drawing in water from the bilges. Assume the total load to be 200 pounds.

As we are assuming the pumps to have traveled about two-thirds of the up stroke, the inertia forces will be very small, so we will suppose the load on the circulating pump rod to be diminished by the amount allowed for inertia. This would make the load about 1,500 pounds.

Proceeding as before, with the loads as shown by Fig. 3, we obtain the values of the forces L_1 and L_2.

Pump.	Load, Pounds.	Arm, Inches.	Moment, Inch Pounds.
F........	— 280	0.	0.
A........	— 10,500	17.5	— 183,750
C........	— 1,500	38.	— 57,000
B........	— 200	53.	— 10,600
	— 12,480		— 251,350

$$L_1 + L_2 = +12{,}480 \qquad 13\,L_1 + 42.5\,L_2 = +251{,}350$$
$$13\,L_1 + 13.\ \ L_2 = +162{,}240$$
$$0 \quad + 29.5\,L_2 = +\ 89{,}110$$
$$L_2 = 3{,}021 \text{ pounds}$$
$$L_1 = 9{,}459 \text{ pounds}$$

$$\text{Shear at } F = -\ \ 280$$
$$+\ 9{,}459$$
$$\text{Shear at } L_1 = +\ 9{,}179$$
$$-\ 10{,}500$$
$$\text{Shear at } A = -\ 1{,}321$$
$$-\ 1{,}500$$
$$\text{Shear at } C = -\ 2{,}821$$
$$+\ 3{,}021$$
$$\text{Shear at } L_2 = +\ \ 200$$
$$-\ \ 200$$
$$\text{Shear at } B = \ \ 000$$

$$\text{Bending moment at } L_1 = -\ 280 \times 13. = -\ 3{,}640$$
$$9{,}179 \times 4.5 = \ 41{,}305$$
$$\text{Bending moment at } A = \ 37{,}665$$
$$-1{,}321 \times 20.5 = -27{,}080$$
$$\text{Bending moment at } C = \ 10{,}585$$
$$-2{,}821 \times 4.5 = -12{,}695$$
$$\text{Bending moment at } L_2 = -\ 2{,}110$$
$$200 \times 10.5 = \ 2{,}100$$
$$\text{Bending moment at } B = -\ \ 10$$

It will be seen by comparing Figs. 2 and 3 that the bending moments are greater for the conditions shown in Fig. 2 than for those shown in Fig. 3, so the size of the beam at L_1 and A can be made such that the stress will not exceed 5,000 pounds, with a bending moment of 40,300 inch-pounds at L_1, and 41,910 inch-pounds at A. Since the moment of inertia of a circular section is $\frac{\pi D^4}{64}$, the diameter necessary to resist the bending moment of 40,300 inch-pounds

$$= D = \sqrt[3]{\frac{40{,}300 \times 64}{2\,\pi\, 5{,}000}} = \sqrt[3]{82.1} = 4.35 \text{ inches, use 4.5 inches.}$$

Since the upper end of the air-pump rod is 2 inches in diameter and pierces the beam, the section of the beam in way of the rod will have a moment of inertia of

$$\frac{\pi D^4}{64} - \frac{2 D^3}{12} = \frac{D^3(3\,\pi D - 32)}{192}$$

In order to resist the bending moment of 41,910 inch-pounds with a stress of 5,000 pounds, the diameter will have to be such as to satisfy the following equation:

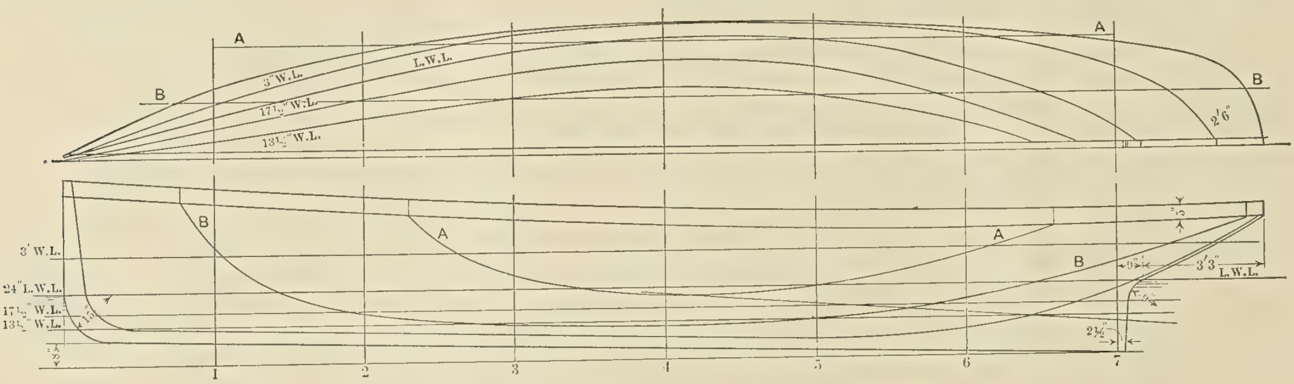
$$D^2(3\,\pi D - 32) = \frac{41{,}910 \times 192}{2 \times 5{,}000} = 805$$

By trial we find that $D = 5.87$ satisfies the equation. We will use 6 inches diameter and flatten it off a little at top and bottom to provide bearing for the nut and shoulder of the rod.

The bending moment on the beam half way between F and L_1 will be one-half of what it is at L_1, so the diameter there must be at least

$$D = \sqrt[3]{\frac{20{,}150 \times 64}{2\,\pi\, 5{,}000}} = \sqrt[3]{41.5} = 3.46, \text{ use 3.5 inches.}$$

The beam between A and C could be turned down to 4.5 inches diameter if desired, but usually it is left as shown in Fig. 1.



LINES OF LAUNCH FOR ISTHMIAN CANAL COMMISSION.

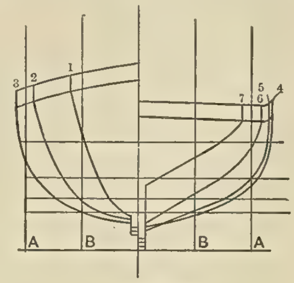
GASOLINE (PETROL) LAUNCH FOR THE ISTHMIAN CANAL COMMISSION.

BY STEPHEN P. M. TASKER.

The illustration shows a type of boat recently designed and built for the Isthmian Canal Commission for use in Colon harbor. The boat is an open launch of sound and heavy construction, designed to be seaworthy and capable of standing a considerable amount of rough sea. It is 32 feet long, with a beam of 7 feet, a draft of 2 feet, a freeboard at the bow of 3 feet and at the stern of 2 feet 1 inch, and a minimum freeboard of 1 foot 11 inches.

The keel is of oak, 4 inches thick, sided 5 inches, and the ribs are of sound, white oak, 1¼ inches square. The shear strake is of 1-inch white oak, with half-round oak strips at the top and bottom running the full length of the boat. The planking is ⅞ inch white cedar, copper fastened throughout, and the hull is sheathed with 14-ounce copper to a height of 3 inches above the waterline. The deck beams are of oak, 1¼ inches by 3 inches, and the coaming is of white oak, extending 8 inches above the deck level. The decking is of quartered white oak, laid fore and aft, blind fastened. The decks are laid flat and fitted with two bow chocks, two quarter chocks and two deck cleats with bronze. The forward deck is 7 feet long and the aft deck 6 feet long. The cockpit is sealed up on the inside with ⅜-inch cypress, and has a seating capacity for about twenty-five people, the seats being of ⅞-inch cypress with oak nosing, on both sides of the cockpit, with lockers underneath.

The forward locker is so arranged that the gasoline (petrol) tank may be taken out, and the flooring throughout the launch



BODY PLAN.

is put down so as to facilitate cleaning of bilges. The ordinary steering wheel and drum are supplied, actuating a bronze rudder, 14 inches by 24 inches. The gasoline (petrol) tank is of galvanized iron, and holds 35 gallons. It is fitted with two interior bulkheads, to prevent swashing of the oil in a seaway.

The floors are ⅞-inch by 3-inch oak, and the engine foundation is of 2-inch white oak.

The power is supplied by a four-cylinder, four-cycle, medium-duty gasoline (petrol) motor of 10 horsepower with reverse gear, make-and-break ignition and Bosch magneto timed with the motor. The propeller shaft is of Tobin bronze, 1¼ inches diameter. The propeller itself is a solid three-blade manganese bronze wheel, 18 inches diameter and 18 inches pitch. The pitch is kept down in this case on account of the work required of the motor and launch. The bore of the motor is 3½ inches and the stroke 5 inches. With the reverse gear it weighs 560 pounds. The normal speed is 600 revolutions per minute and the minimum 125. The diameter of the crankshaft is 1½ inches and the exhaust pipe 1¼ inches, with ½-inch sea connections. The circulating water is carried around the exhaust manifold, and then overboard, but there is a by-pass, so that the cooling water can be discharged into the exhaust pipe and pass out with the spent gases at the stern, thereby keeping the temperature of the pipe down considerably. It is a good plan to use this by-pass, and just before the motor is stopped to shut the valve and discharge all water overboard. By running a short time with no water passing through the exhaust pipe the pipe is heated and thoroughly dried before the motor is stopped. This lengthens the life of the pipe considerably. The exhaust pipe with the muffler is carried aft and discharges above the waterline under the counter.

This launch was designed by Tasker & Strawbridge, engineers and naval architects, Philadelphia, Pa.

THE MARINE STEAM ENGINE INDICATOR — IX.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

REDUCING MOTIONS (CONTINUED).

Every marine engineer who has served on vessels with vertical propelling engine is more or less familiar with the lever reducing motion in one or more of its various forms. In nine cases out of ten he has probably used gears like that shown in Fig. 61 or Fig. 63. These gears contain the minimum number of parts, are easy to lay out and make, and give a reciprocating motion, and that is about the best that can be said of them. In length, the main levers are about one and one-half times the engine stroke, and the deviation of the actual gear from a true motion is not quite as great as shown in the figures. These diagrams have been purposely drawn with short connections in order to make the errors visible at a glance.

Referring to Fig. 61: *A B* is the line of stroke of the engine. The pin attached to the cross-head is indicated at 5.

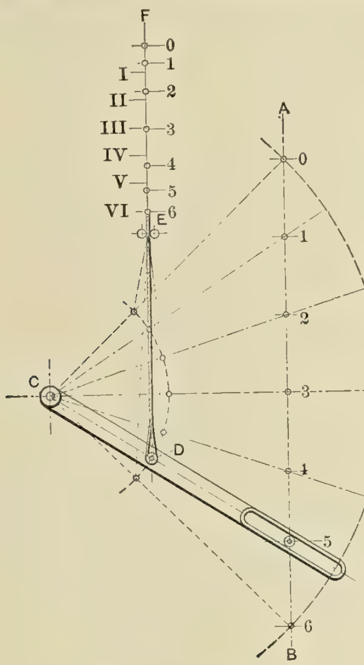


FIG. 61.

The position of this pin when the engine is on the top and bottom centers is at 0 and 6, respectively. Five equally spaced intermediate positions are indicated at 1, 2, 3, 4 and 5, the stroke being thus divided into six equal parts. The lever fulcrum is attached to the housing at *C*. The bight of the indicator cord is slipped over the pin at *D*, rove through a fair-leader or guide pulley at *E*, and thence to the indicator drum. The fair-leader at *E* has purposely been placed close to the lever in order that the effect of the cord angularity may be readily observed. The horizontal lines at the right of *F E* and numbered from 0 to 6 show the actual spaces passed over by any point on the indicator cord, while the horizontal lines to the left (marked in Roman numerals) indicate what the true position should have been when the engine cross-head was at the correspondingly numbered positions on its line of stroke. A glance at the diagram will show that the arcs described by the main lever are not equal for equal movements of the cross-head.

In Fig. 61 the distance from 3 to *C* is equal to one-half the engine stroke, and therefore the arcs described by the lever in its movement from 0 to 6 are as follows for each equal space passed over by the cross-head: 11° 19′, 15° 15′, 18° 26′, 18° 26′, 15° 15′ and 11° 19′.*

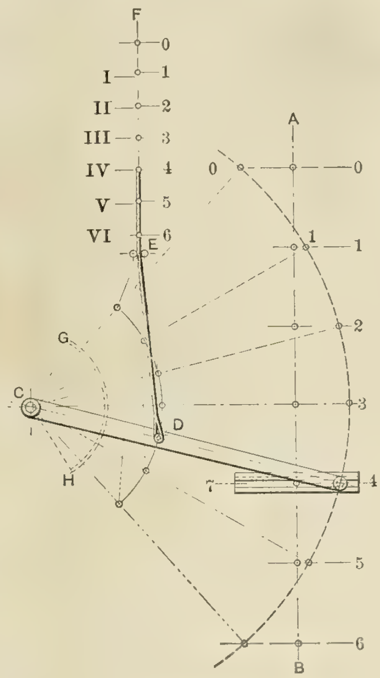


FIG. 62.

Fig. 62 shows another form of simple lever. Here a horizontal slotted guide is fitted to the cross-head, which guide engages a fixed pin in the lever end. This pin passes over equal divisions of the stroke with the cross-head, and if it were not for the necessary angularity of the cord, this gear would be

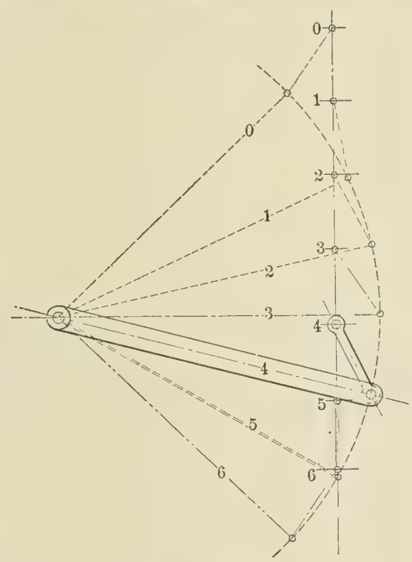


FIG. 63.

accurate, and where the cord is long, the deviation from a true motion is very small. In the movement illustrated in Fig. 61, the lever described the smallest arcs when near the ends of the stroke. In Fig. 62 the reverse is the case, and the arcs are as follows: 18° 35′, 15° 31′, 14° 29′, 14° 29′, 15° 31′, 18° 35′; the distance from the pin center at 4 to the fulcrum at *C* being equal to four-sixths of the engine stroke. This gear gives the same motion as that obtained from the mechanism shown in Figs. 53 and 54 (March issue).

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* Tan 0C3 = 3/3 and 0C3 = 45°.
Tan 1C3 = 2/3 and 1C3 = 33° 41′ +.
Tan 2C3 = 1/3 and 2C3 = 18° 26′.

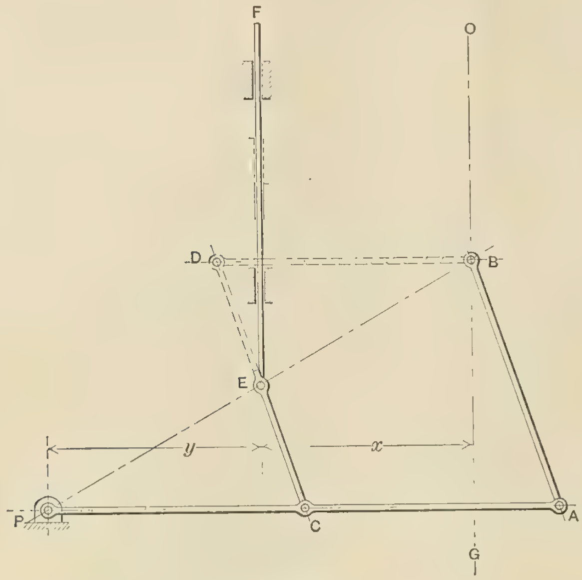


FIG. 64.

A device known as a brumbo pulley is sometimes fitted to levers of this kind. It consists of a sector with a grooved edge, around which the cord is passed. The arrangement is indicated by the broken lines at *C G H* (Fig. 62), the cord being fastened at *H*. While this pulley disposes of the cord angularity, it preserves the entire angular error and is better omitted.

A reducing motion, which is perhaps more common, is illustrated roughly in Fig. 63. It is easier to make and fit than those connected by sliding contacts, but the reduction is still more irregular, as may be seen by a glance at the cut.

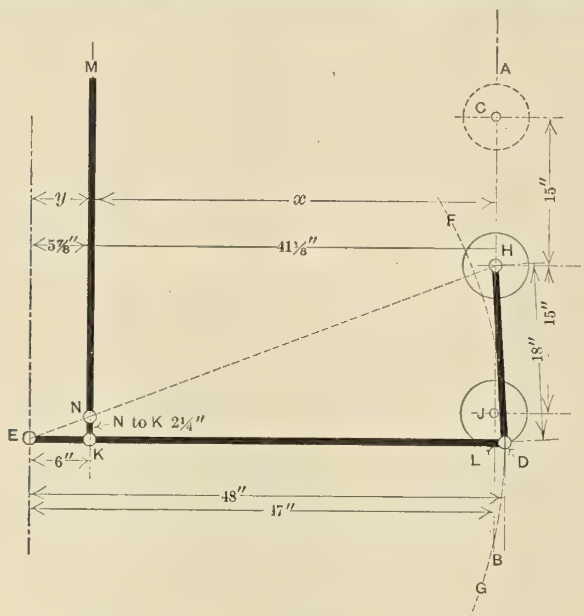


FIG. 65.

As marine engines are almost always provided with a reducing motion, constructed at considerable expense and designed for the particular engine to which it is attached, there can be no excuse for fitting a gear which is sure to give inaccurate readings, when one which is absolutely correct in design can be made at small additional cost.

The principle of the pantograph was discussed at length in the August, 1909, issue, but for the convenience of the reader who has not that paper at hand the subject will be briefly reviewed here. Consider the diagram, Fig. 64. *C D* is a continuous bar, with an intermediate eye at a point to be determined. *A B* equals *C D* in length. *A P* is another bar of any desired length, with an eye at *C* located at a distance from *A* equal to *B D*. The bars are connected by pins at *A, B, C* and *D*, forming a parallelogram. *P* is a fixed bearing on the engine housing, and *B* is attached to the engine cross-head. Draw the line *B P* and drill *E* at the point where it cuts the center line of *C D*. Now, in whatever position this mechanism is placed, *B, E* and *P* will lie in the same straight line,* and any motion imparted to *B*, whether curved, irregular or straight, will be copied by *E*, but on a smaller scale.

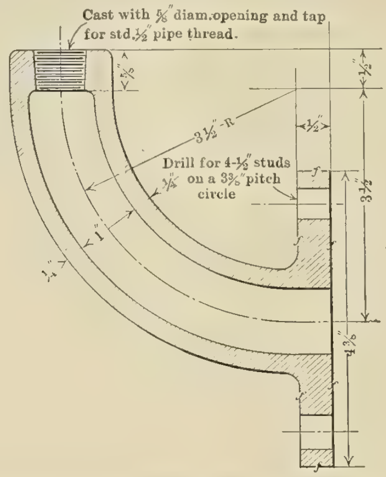


FIG. 66.—LONG-TURN FLANGED ELBOW FOR L. P. ENGINE. MAKE TWO OF COMPOSITION.

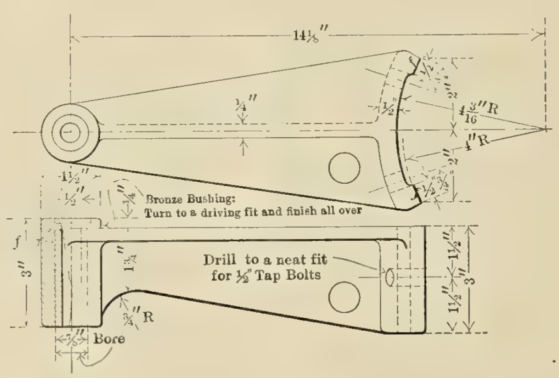


FIG. 67.—UPPER GUIDE FOR L. P. ENGINE. MAKE ONE OF CAST IRON.

The ratio of reduction will be $E\ P \div B\ P$, or, what is the same thing, $C\ P \div A\ P$. Now, as *B* is attached to the engine cross-head, it must necessarily move in the straight line o *G*, parallel to the engine center line and at a distance *X* from o *G*, will move in a straight path parallel with the same line. If a rod be connected to *D C* at *E*, arranged to work in guides parallel to the engine center line and at a distance *X* from o 6, it follows that that part of the mechanism shown in broken lines (*B D E*) may be removed without destroying the pantographic principle in the constant velocity ratio $\dfrac{y}{y+x}$.

* By geometry: "If a line be drawn between two sides of a triangle (in this case *A P* and *B P*) parallel to the third side (*A B*), the triangle formed (*C P E*) is similar to the given triangle (*A P B*)." Also, "if triangles are similar, their homologous sides are proportional." As *A B* and *C E* are parallel by construction, these theorems apply here, and $\dfrac{C\,E}{A\,B} = \dfrac{C\,P}{A\,P}$. Multiplying both sides of the equation by *A B*, we have $C\,E = \dfrac{A\,B \times C\,P}{A\,P}$, from which we see that *E* must always occupy the same place on *C D*, because the second or right-hand member of the last equation is composed of constant factors. The same reasoning applies to all other forms of the pantograph.

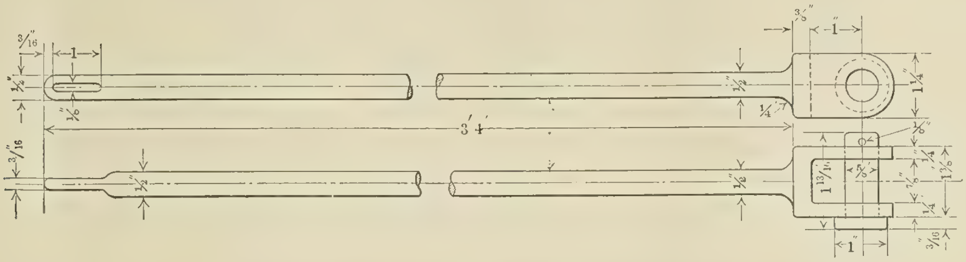


FIG. 68.—GUIDE ROD FOR L. P. ENGINE. MAKE ONE OF MILD STEEL.

To lay out a practical gear of this kind we should proceed somewhat as follows: Consider, first, the card length, or the vertical travel of the guide rod *E F* in Fig. 64. With low rotative speeds a large diagram is possible and desirable, and

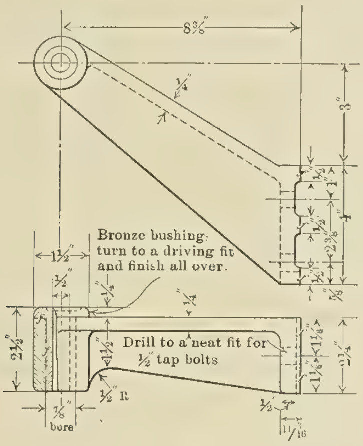


FIG. 69.—LOWER GUIDE FOR L. P. ENGINE. MAKE ONE OF CAST IRON.

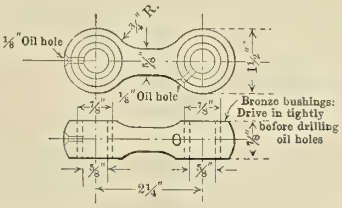


FIG. 70.—GUIDE ROD LINK. MAKE ONE OF MILD STEEL.

some indicators admit of a drum travel, which gives a card 5 inches long; but as the revolutions increase, the diagram or card length must be diminished, in order that distortions, due to inertia, may be reduced to the lowest terms. With speeds below 100, cards of 4 inches length and over are proper; between 200 and 100, diagrams between 3½ and 4 inches should be provided for. For still higher speeds the maximum lengths recommended are: for 300 revolutions per minute, 3¼ inches; for 400, 3 inches to 2¾ inches, and for 500, about 2½ inches.

Problem: Given a high-speed short-stroke engine, with cast back columns bolted to the condenser top; revolutions per minute 160; stroke 30 inches; center line of the cylinders to back of the housing at the condenser top 49 inches; center line of the cross-head pin on the top center to the top of the lower

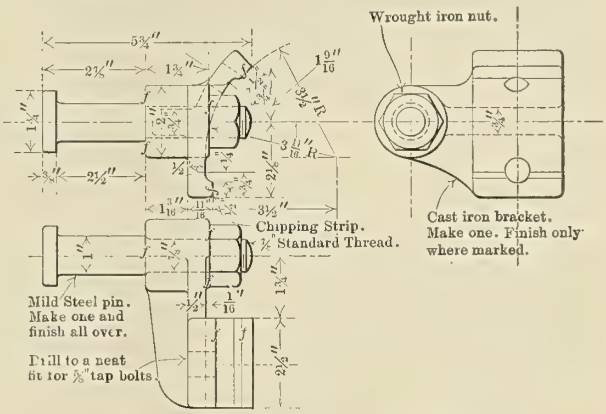


FIG. 71.—LEVER BRACKET FOR L. P. ENGINE.

housing flange 34 inches; length of the indicator diagram 3½ to 4 inches.

Required: A dimensioned sketch of a correct reducing motion.

Lay down the center line of the engine *A B* (Fig. 65). Locate the center of the cross-head pin when on the top center at *C*. Inspection of the engine frame shows that the center of the main-lever fulcrum can be conveniently located one inch above the top of the lower housing flange and 3 feet 11 inches from the center line of the cylinders. Measure down 2 feet 9 inches from *C* and draw *D E* at right angles to *A B*. Locate the main lever fulcrum center on this line 3 feet 11 inches

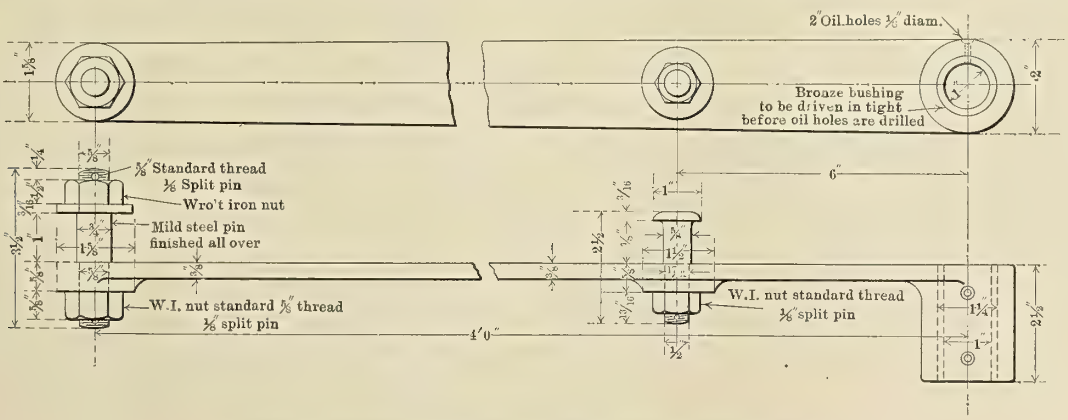


FIG. 72.—LEVER FOR L. P. ENGINE. MAKE ONE OF WROUGHT IRON.

to the left at E. As it is desirable, but not necessary, that the main lever end swing a little on each side of A B, try 4 feet for the lever length, and with this radius and E as a center, sweep in the arc F G. From C measure down 15 and 30 inches and locate the cross-head at mid stroke, and at the bottom center at H and J. From H to the intersection of A B and D E is found to be 18 inches.

Use this length for the cross-head link and draw H D. Divide the stroke of the engine by the card length for the velocity ratio. In this case, for a 4-inch card, it is found to be $7\frac{1}{2}$. As this ratio will give inconvenient fractions, try 8, and we get a card $\frac{30}{8}$ or $3\frac{3}{4}$ inches long, which is within the limits set. This means that the pin on the main lever for the

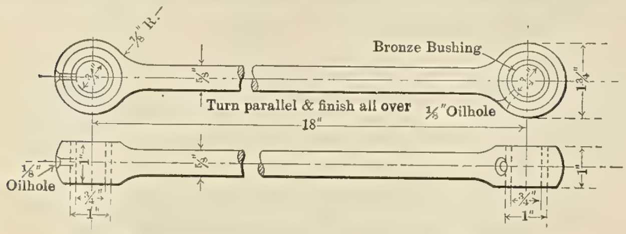


FIG. 73.—CROSS-HEAD LINK. MAKE ONE OF MILD STEEL.

short or guide-rod link must be located one-eighth of the lever length from its fulcrum. From E, measure $\frac{48}{8}$ or 6 inches to the right and mark the short link pin center at K.

To locate the guide rod: Let the athwartship distance between the engine center line and the guide rod center line be denoted by x. The value of x is found by the proportion $x : D\ K :: L\ E : D\ E$. Substituting the dimensions already found, we have

$$x : (48 - 6) :: 47 : 48$$

That is, $x = \dfrac{42 \times 47}{48}$ or $41\frac{1}{8}$ inches.

Set off this distance to the left of A B and draw M N parallel to it. Draw N K, the guide-rod link. Let y represent the length of N K; then $y : 18 :: 6 : 48$ and N K will be

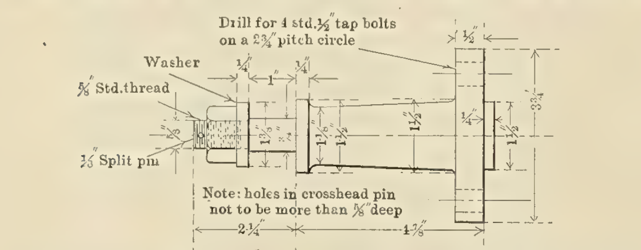


FIG. 74.—CROSS-HEAD STUD FOR L. P. ENGINE. MAKE ONE OF MILD STEEL.

$\dfrac{18 \times 6}{48}$ or $2\frac{1}{4}$ inches long.

A reducing motion of this kind in arrangement and details, as actually fitted—with such modifications as experience has shown to be desirable—is shown in Figs. 66 to 75. The drawings are self-explanatory.

This mechanism has been in use for over ten years and has given the utmost satisfaction. It will be noticed that all wearing parts are fitted with removable bronze bushings, and that the cross-head stud is so made that the original lathe centers are preserved. This last detail is of no little importance when it comes to truing up these important journals after years of wear.

(*To be continued.*)

Reinforced Concrete Barges.

The construction of three reinforced concrete barges for use on the Pacific Division of the Panama Canal has been started at Corozal. Each will be 64 feet long by 24 feet wide and will have a depth of 5 feet 8 inches. The interior beams and columns will have a spacing of 10 feet longitudinally and 8 feet transversely. Two interior longitudinal walls will extend through, with a bulkhead at each end forming an interior compartment, 40 feet long by 8 feet wide. The shell of the barges will consist of one layer of ½-inch mesh No. 12 wire cloth, ½-inch transverse rods, spaced 8 inches on centers and ½-inch longitudinal rods, spaced 12 inches on centers, all securely fastened to the reinforced concrete frame work. Over this several coats of Portland cement mortar will be laid, with an additional coat laid on from the inside.

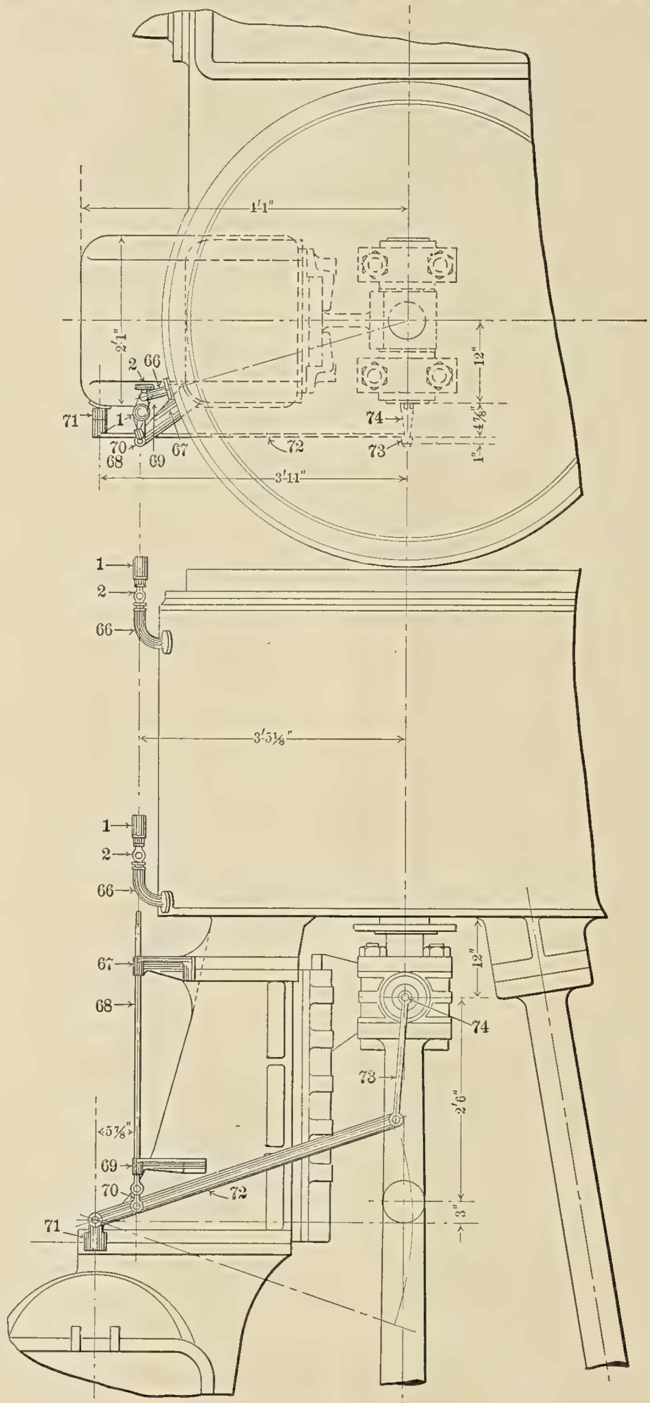


FIG. 75.

DANISH PETROLEUM AND CRUDE OIL MOTORS.

BY AXEL HOLM.

Petroleum and crude-oil motors are in extensive use all along the shores of Denmark as main and auxiliary power for fishing vessels, a trade which puts a very severe test on a marine motor. It would probably be hard at present to find a fisherman on the Danish or Norwegian shores not fully familiar with the handling and treatment of a petroleum motor, and as a result manufacturers of this special type of motor have attained very nearly the ideal combination of reliability, economy and simplicity.

It was the severe competition with trawlers and other steam-fitted vessels from more wealthy countries, such as England, Germany and France, that first forced the fishermen and the manufacturers on this road, and it is remarkable that it is now due solely to the extensive use of motors in the trade that the Danish fishermen are able to keep pace with the foreigners and make a living on their native waters. It is also a matter of fact, that when the British government in 1905 appointed a board for investigating the same problem for Scotland, viz., how the Scotch sailing-fishermen could be helped in the competition against the steam-fishermen, the board found the most available motor for the purpose in Denmark.

Up to the present date these motors have been installed principally in old sailing vessels, never intended for internal motive power, and often put down in the crew's cabin, where they have worked satisfactorily for years, but, of course, now the fishing boats are especially designed and built for carrying motors as auxiliary power. The advantages of these motors, even when compared with the producer-gas motors, are apparent when it is considered that they are constructed to work with heavy, cheap oil, without electrical or open-flame ignition, and without a carburetor or other sensible vaporizer.

Motors on these principles are especially built by three firms in Denmark, the Dan Marine Motor Company, Copenhagen, L.; the Mollerup Motor Works in Esbjerg, and the Alpha Motor Company, Brothers Haumoller, in Frederikshaven; but as they are all very much alike, only differing in the arrangements and details, I can explain them altogether from a drawing of a Dan motor (Fig. 1).

The fuel (petroleum, kerosene or any kind of heavy oil) is carried in tanks as usual, but the tanks need not be arranged higher than the motor, or with internal pressure in order to force the fuel to the carburetor, as it is pumped out by a pump on the motor, and neither need the outlet be put in the bottom of the tank, thus preventing leakages. But even with a leaky tank this kind of oil, when collecting in the bilge, causes no danger of explosions in the engine room, as would be the case with gasoline (petrol). It is said that the woodwork of the boat will, time after time, be saturated with petroleum, but this matter has not caused any serious accident so far, and it might be prevented, to a certain degree, by proper care. On smaller-sized motors the tank is usually placed directly on the motor on brackets from the bedplate (*F T*, Fig. 1).

The oil is forced by the fuel pump into a heated chamber *V* on top of the cylinder and in free connection with it by a narrower neck, but with no connection at all with the air and exhaust valves which control the admission and expulsion of the main charges. The oil is instantly converted into vapor by being sprayed on the red-hot walls of the vaporizing chamber without causing any deposit to form upon the walls. The fuel is taken through a fine sieve before entering the pumps. The vapor is not mixed with air immediately upon its admission, but remains unexplosive until the compression stroke. The valves for the exhaust and air admission *E* and *A* are arranged side by side, both being spring valves and governed by a secondary half-speed shaft, which also operates the fuel and water pumps.

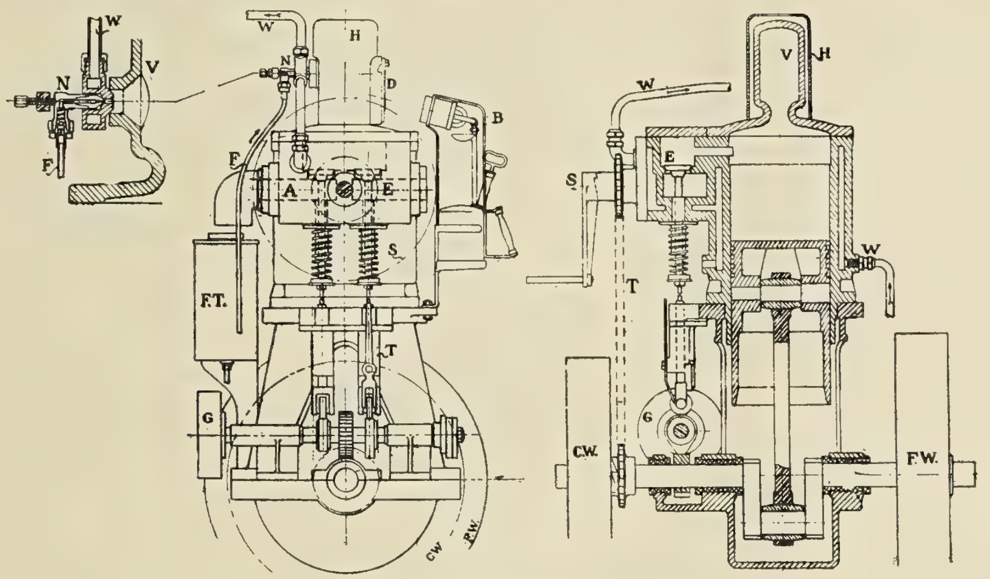


FIG. 1.—DETAILS OF SINGLE-CYLINDER DAN MOTOR.

As these motors are all of the four-cycle type, during the first downward stroke the piston draws in air through the valves, together with a small quantity of vapor from the chamber, into which the fuel is sprayed at the end of this stroke. In the second stroke upward the air is compressed, its temperature thereby raised and forced with great velocity through the narrow neck into the hot vaporizing chamber, where it mixes with the petroleum vapor and becomes inflammable. The ignition will take place in the chamber before the end of this stroke (at from 80 to 120 degrees F.), but on account of the narrow neck and the force of unmixed air rushing through it, the explosion cannot spread to the cylinder before the piston starts the third and power stroke. The fourth stroke is the exhaust stroke. It is claimed that the motors practically never miss an explosion, and that the expulsions are perfectly clean and smokeless. The compression is not very high, about 45 pounds per square inch, the explosion pressure ranges between 130 and 150 pounds per square inch, and the mean pressure is only about 30 pounds. This accounts for the comparatively large dimensions of the

motors. The speed ranges between 300 and 400 revolutions per minute.

From the foregoing it is evident that the motors work on the old original four-cycle system and no new or experimental principles are developed.

The governing of the fuel supply is done both automatically and by hand. The fuel pump draws at each stroke a small quantity of oil from the tank and delivers it directly through the sprayer-nozzle *N* into the vapor chamber, but the amount injected is varied in accordance with the load on the engine by the governing mechanism *G*, which automatically alters the stroke of the pump plunger if the speed of the motor tends to increase. A hand adjustment, secured by a thumbscrew in reach of the helmsman, acts directly upon the governor, and the quantity of oil admitted to the engine thus allows any speed to be maintained for as long a period as may be desired. With the additional control, permitted by the use of a reversible propeller, the management of the vessel is very simple and effective, being under perfect control of one person and calling for no special skill or training.

The water-cooling system is very elaborate, the cylinder, the valves, the sprayer-nozzle, the muffler and sometimes the protecting hood over the vapor chamber all being cooled.

When the engine is to be started, the flame from a wickless self-vaporizing blow lamp *B* is directed against a certain portion of the walls of the vaporizer through a door *D* in the protecting hood *H* for about ten to fifteen minutes. When at the end of this time the bulb becomes glowing hot, the crankshaft is rotated and the motor thus started by means of a self-raising handle and a separate shaft and a transmission chain *S* and *T*. In this way a man can start the motor standing right back of it, and no space is required forward of the fly-wheel for the starting handle and the fore-and-aft length of the motor is thereby reduced as the forward engine room bulkhead can be placed close to the fly-wheel. By this operation the piston is caused to move through the charging and compression strokes and to inhale and mix the vapor and air previous to the ignition stroke. After two or three revolutions the motor commences to work, and after a few minutes the blow-lamp can be taken away, as the vaporizer is thereafter kept at a constant high temperature by being subjected to the heat of the regular explosions inside. The stopping is done by cutting off the oil supply.

The glowing vaporizing bulb is, of course, the most delicate point on these motors, as it seems liable to crack from the heavy stresses put on it from inside, when the material is furthermore weakened by the high temperature, but good material and workmanship will provide against this, and the protecting hood over the bulb will keep the pieces of a broken bulb from doing any damage by flying around in the motor room. In fact this trouble very seldom occurs and has never caused any serious accident during the time (over ten years) that these motors have been in use. The bulb cannot be water-cooled, of course; but it is always covered by the hood, and this on some of the engines is water-cooled.

The mufflers are usually placed directly on the motor, and the exhaust is practically noiseless. There is considerable noise in the engine room from the valves, but this is of only minor importance in the kind of work for which these motors are constructed.

The motors are always started free, and the propeller coupled on after the start—all kinds of couplings being used, but usually friction couplings—and the reversing is now always done by reversing propellers. After many experiments this has been decided as the most reliable device for heavy work.

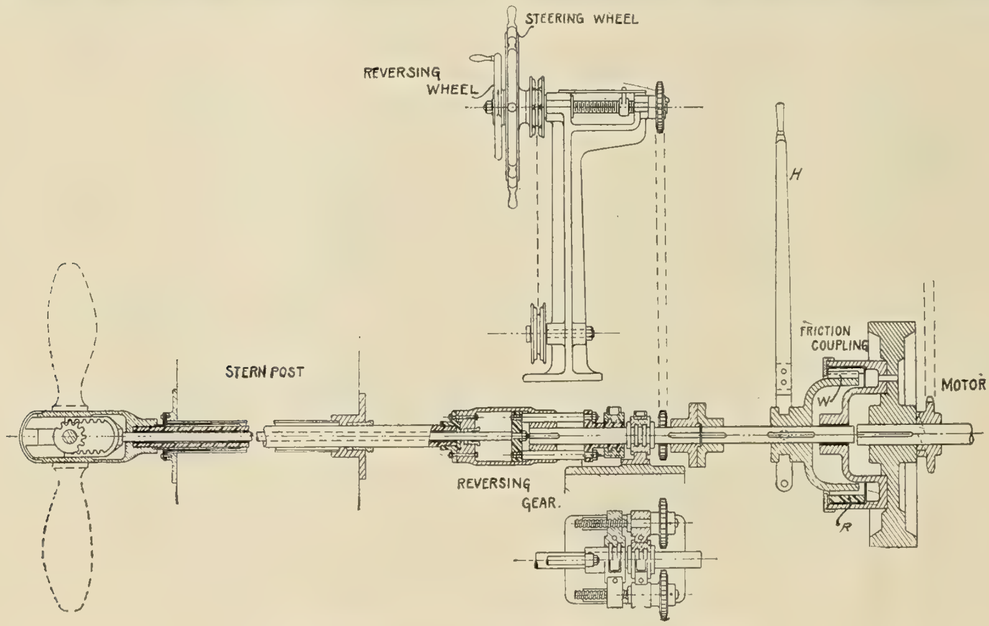


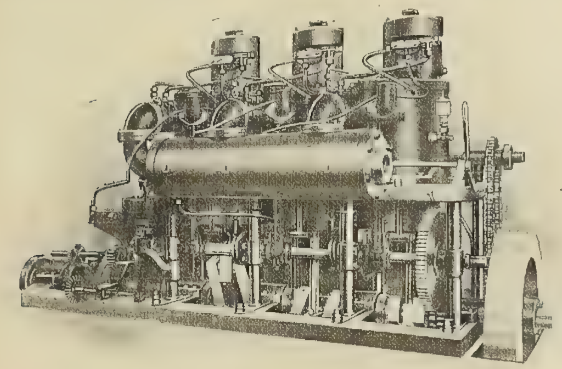
FIG. 2.—COUPLING AND REVERSING GEAR OF DAN MOTOR.

In the plan, Fig. 2, is shown the friction coupling and reversing gear of a Dan engine. In the friction coupling is a steel spring-ring *R* cut at a point, and by moving a wedge *W* in this cut in a forward direction the ring is widened out and brought into strong friction over its whole surface with the friction wheel on the motor. The control of the wedge is by means of a handle *H* as shown. The reversing is done by the helmsman by means of a swing working by a transmission chain on two screws on both sides and parallel to the propeller shaft, and these screws will move the reversing rod in the hollow propeller shaft in a fore-and-aft direction. An indicator on the swing-stand always shows the helmsman the position of the propellers. Apparently this arrangement will require a long shaft, thus making the engine room of considerable length in the fore-and-aft direction, but one must remember that this reversing gear can be put way aft where the lines of the vessel are fine and the space practically useless, or under the cabin floor where it is well out of the way.

Due to the fact that the combustion of the fuel is complete, these motors can be run months without any cleaning of the cylinders and valves. When troubles of this kind at last occur, they generally originate from the clogging up of the fine opening in the sprayer-nozzle of the fuel-supply pipe, but as this is held in its place on the vaporizing chamber, to-

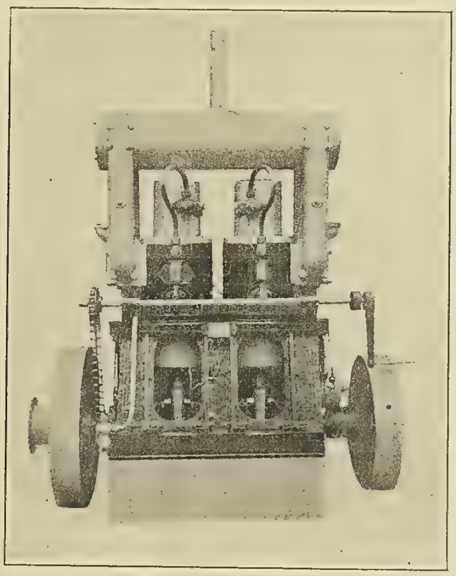
gether with its water-cooling collar by only one screw, it may be quickly removed and the opening cleaned by a piece of fine wire. The mouth-piece is also interchangeable, and a spare piece can always be kept in reserve. This whole arrangement is shown in detail in Fig. 1

As they are intended for rough and heavy work, the motors are quite heavy, the weight being about 275 to 500 pounds per brake horsepower for single-cylinder engines, 200 to 350 pounds for two-cylinder, and 150 to 300 pounds for three-cylinder engines, not including propeller, propeller shaft, reversing gear and tanks. The consumption is stated by the manufacturers to be as low as ½ pound per horsepower per hour for common Texas oil, and is guaranteed not to exceed 1 pound per horsepower hour. In his report to the British



THREE-CYLINDER, 30-HORSEPOWER ALPHA MOTOR.

government, Lieutenant Cummings states that the 25-horsepower Dan motor experimented with would use for one-half penny's worth of oil per horsepower hour, and for a run of 17 hours' duration 40 gallons of oil. The boat used was an ordinary Scotch fishing smack, measuring 72 feet over all, with 21 feet beam and drawing about 8 feet of water aft. The fuel may be the ordinary commercial petroleum with a



40-HORSEPOWER MOLLERUP MOTOR.

specific gravity of 0.8, or crude oil of about the same specific gravity, but the motors can be run on any kind of cheap and heavy oil when specially arranged for it.

As previously stated, the fishing trade is putting the severest test on a marine motor as to its reliability and handiness, and it certainly is surprising to see these motors, rusty, dirty and roughly handled, working steadily away without trouble for

TYPICAL DANISH FISHING SMACK FITTED WITH A 10-HORSEPOWER MOLLERUP MOTOR.

years, managed by the fishermen themselves with very little cost. The Danish government uses these motors at the Greenland shores, and between the Danish Antilles. They are in use in East India and in South America, they are winning their way all along the European shores, and, while the United States, so far has not been tried as a market, it is probably due to the high import duty on machinery.

MODERN MOTOR BOATS.

BY GEORGE H. CUTBUSH.

The development of the internal-combustion engine has opened up many new fields, but none more extensive than that offered by vessels of moderate size. The introduction of a motor giving a high power for its weight made possible many types of boat hitherto impracticable, while in the case of low powers it has already largely replaced steam, and in the case of higher powers promises to do so at no distant date.

In the present article, however, it is not proposed to discuss the future possibilities of the internal-combustion engine, or whether it will ever successfully compete with the powerful triple and quadruple expansion engines and the turbines employed on liners and warships, but to review present practice, and to show how such engines are daily altering existing conditions and giving more efficient service than has been practicable hitherto.

There is not much history attached to the motor boat, less even than attaches to the motor car, as the former to some extent started after the latter had surmounted its early difficulties. As far back as 1863 an internal-combustion-engined boat was in commission. This boat, the *Djezisely,* was the property of the Marquis d'Naie d'Aulais, and was fitted with a Lenoir engine, driven by gas stored in cylinders under pressure. Failing the gas producer, which even yet is not altogether practical, it was by the use of the oil engine alone that the motor boat was developed, and it was not until car makers had shown how light and compact the internal-combustion engine could be constructed that motor boats became popular.

At first they were pleasure craft only, and the same type of engine as used in cars was mostly employed. It was soon recognized, however, that land and marine conditions are very different. In the first case, the engine but seldom exacts its full power, running mostly at a half or a third of its capacity. The marine engine, however, has to run practically constantly at full load, and therefore its speed, if undue wear is to be prevented, must be considerably lower than that of the car engine. Reducing the speed necessarily entails an increase of weight, and so we find marine engines of considerably greater

weight for their power than car engines. In the smallest engines used for pleasure craft the weight is not much greater, but engines for industrial boats are generally heavily built. In Europe the motor boat has suffered somewhat from its connection with racing. Light racing engines on car lines, fitted into the lightest of hulls, gave speedy but unreliable craft, and it is only since it came to be recognized that the marine engine was an entirely distinct type that real progress has been made. In the States, on the other hand, racing has played but a small part in the development of the marine motor, and accordingly American engines quickly became popular on account of their reliability, with the result that large numbers of such motors, chiefly of the low-powered order and many of the two-cycle type, are yearly imported into the United Kingdom and the Colonies.

The principal factor in marine engine design is its constant running under full load. For this reason all bearings and seatings must be of ample area, and cast iron will be found a better material for the crank case than aluminum. Noise and vibration are noticeable in a boat, and as they depend largely upon speed the revolutions must be low. For marine steam engines a piston speed of about 600 feet is rarely exceeded, and this figure may be taken as a suitable one for marine internal-combustion engines of any size.

Lubrication is another important detail, and for good results under all conditions some forced feed system is well nigh essential. While over-lubrication is to be avoided on the score of waste, it is not so objectionable as in the case of a car engine, as the exhaust is in all large boats turned into a funnel.

Small marine sets up to 20 horsepower should be as far as possible self-contained with control board, magneto or accumulators, reverse gear, etc., all mounted on the one frame, so as to require a minimum of trouble when installing in the hull. Many boat builders capable of turning out an excellent hull are not to be relied upon in fitting the engine, and the power plant should therefore be as complete in itself as possible to avoid mal-alinement. As already mentioned, cast iron is the best material for the crank case, as it is far stiffer than aluminum and gives a rigid seating for the bearings, while it is not attacked by sea water as aluminum is. The bearings should be carried on the lower half of the case, and the arms for securing the engine to the bearers also. Doors should be provided in the crank chamber of sufficient size for the main bearings to be inspected or adjusted without taking down the engine. With engines of any size accessibility is a highly important feature, owing to the limitations of space in the usual engine room. Engines should be designed so that all repairs and renewals can be made without taking the engine out of the boat, as in many cases the presence of the deck would render this a matter of difficulty. It should be possible to adjust or replace any bearing, or even remove the crank shaft, with the engine in place. In this connection engines should be accessible from the side, as to remove a cam or crankshaft endwise would entail an engine room twice as long as the engine. To again revert to the crank case, it is by no means certain whether the larger types of marine engine running at comparatively low speeds need to be enclosed. An open engine is light, and lends itself to examination while running. In the case of a hot bearing, water can be run over it, while repairs or adjustments are facilitated. In this connection it is interesting to note that the *Gregory*, the only high-speed motor boat to cross the Atlantic, is fitted with open engines carried on steel columns. The installation of this craft consists of two six-cylinder petrol engines of 12 inches bore and 14 inches stroke, giving a total horsepower of about 700, driving twin screws. The engines are reversible, this operation as well as starting being carried out by compressed air. For engines of this power, however, gasoline (petrol) is out of the question, on account of its expense, and heavier oils are advisable.

Motors are now on the market capable of utilizing the heaviest of crude oils. The Diesel, for instance, will run on the same oil that is employed for liquid fuel purposes, and while somewhat heavy for its power, it is one of the most economical power producers extant. With most of the engines using heavy oils, some little time is required for heating the vaporizer when starting, and this, while not of much consequence in an industrial craft, is out of the question in a small pleasure boat. For commercial work gasoline (petrol) is, of course, not to be thought of, so in many cases kerosene (paraffin) gives the best compromise in conjunction with a reliable and weather-proof system of electric ignition.

For purposes of comparison, the weights of the different types of engine may be of value. With high-speed steam engines designed for continuous service, it has been found impossible to obtain more than 3-horsepower per hundredweight, and this exclusive of the weight of the boilers and their contents. The heavy oil engine gives practically the same power for weight, although some of the largest engines give considerably less (Diesel 1-horsepower per hundredweight), but it must be remembered that the weight of the boilers, feed pumps, etc., is saved. Kerosene (paraffin) engines as fitted to pinnaces, yachts, etc., run from 2½ to 3-horsepower per hundredweight for the complete installation. High-speed engines for racing boats are in use, giving 5.3 to 6.4-horsepower per hundredweight of complete equipment on continuous runs of a few hours' duration. For hard and efficient service, however, about 3-horsepower per hundredweight for engines under 100-horsepower, this including reversing gear, etc., may be taken as the limit.

Of equal importance to weight, in many cases, is space occupied, and here the internal combustion engine scores every time, making it more suitable than steam in very many instances. Another valuable feature is simplicity. Marine engines are often in the hands of novices, and as a failure may be fraught with serious consequences, simplicity and reliability are very desirable qualities. In many branches of industrial work, such as fishing craft, the men have some knowledge of steam, as they are accustomed to its use for the capstan, but the intricacies of the internal-combustion engine take time to master, with the result that such engines have failed in many instances to give satisfaction. For this reason some consider that a compact steam plant provides a better solution of the problem than the oil engine, and one firm, Scott Engines, Ltd., of Paisley, have designed and fitted to several East Coast fishing boats a steam plant, consisting of a four-cylinder, single-acting engine and compact flash boiler. The engine has the cylinders inclined, so that the entire casing is extremely shallow and can be fitted in the crew space projecting but some 6 inches above the floor. The steam generator, too, possesses the advantage that it can supply the capstan with power, a feat of which the internal-combustion engine has hitherto not been capable.

We will now leave the engine and see how it can be applied to various types of craft, pleasure and commercial. To deal with pleasure boats first, these may be used for river work, for estuaries or for open sea, while motor yachts may be considered as a class in themselves. River boats are generally of the shallow type, and range from the punt, with a 2-horsepower, two-stroke motor, and reversing propeller, to boats 30 feet in length with a four-cylinder engine, with reversing propeller. Messrs. James Taylor, of Chertsey-on-Thames, make a specialty of shallow-draft launches for river and canal use. Their patented design incorporates a flat bottom, which gives stability and carrying power; and the usual tendency of such hulls to rise by the bow and squat by the stern is overcome by arching the floor; from the stern the

highest point being slightly forward of amidships. Aft there is another upwardly curved portion extending from the run to the stern post right over the propeller, so that practically a submerged counter is formed. The cross-section of this portion is rounded to form a tunnel in which the propeller revolves, while a cover allows an inspection of the propeller to be made when desired.

Boats suitable for estuary work are, of course, of deeper and fuller section than those used only up-river, as they have to face broken water. For the open water and general cruising, quite a different type of boat is necessary. Perhaps this type of boat is to be found in no greater numbers than on the Clyde, where the open waters of the Firth, the many arms of the sea and the interesting islands on the west coast have encouraged cruising and developed an extremely hardy type of cabin cruiser. A typical boat of this class is the *Fidus II*, a cabin cruiser 28 feet in length by 7-foot beam by 3 feet 8 inches, fitted with a 12-horsepower Scout engine. This boat is by Maclaren Bros., of Dumbarton, and has been successful in winning the first long-distance race on the Clyde held recently from Hunters Quay to Ailsa Craig and back, a distance of 88 sea miles, and a course held to be proof of a boat's seaworthiness.

For really hard weather many consider that the open cockpit of the usual cruiser is unsuitable, and that built-up topsides on the lines of the American dory are the best. A boat recently completed on these lines is the *Lady Mary*, which is purely American in design, with a big displacement overhanging fore-end and broad quarters. She is 35 feet in length, with a beam and draft of 7 feet 9 inches and 2 feet 6 inches, respectively. Her engine is a 15-horsepower Gardner kerosene (paraffin) motor, driving through a Gie's reverse gear. She has ample cabin accommodation and an enclosed engine room. The auxiliary rig is that of a two-masted schooner and a novel feature is the main mast, through which the exhaust is taken.

The hydroplane depends, of course, upon the presence of a film of air between the hull and the water at high speeds, the low frictional resistance making high speeds possible. The hull is flat, and consists of three or more steps to imprison the air. Broken water, of course, impairs the efficiency of the hydroplane, and for this reason it is not likely to become more than a toy, although the possibilities of torpedo hydroplanes have been discussed, and even of liners built on this principle. For use on smooth water a small torpedo boat on these lines might have some practical value, but it is somewhat doubtful.

Yachts of ever-increasing size are now being fitted with internal-combustion engines. The *Bronzewing* is one of the largest and most luxurious motor yachts in existence. She was built in Sydney, and is used for cruising on the inland waters of the Australian continent, and for journeys to the South Sea Islands, which require a thoroughly seaworthy boat. The length is 120 feet, with a beam of 17 feet, and her hull is of teak throughout. The machinery consists of three sets of 100-horsepower Thornycroft motors, driving triple screws through reversing clutches. The fuel used is kerosene (paraffin), and the engines, which have four cylinders apiece of 8 inches bore and stroke, develop their power at 750 revolutions per minute. A small 6-horsepower engine and compressor provides the compressed air for starting. The use of triple screws makes for economy, as the center engine, or the two wing engines, can be used separately, according to the speed required. A complete installation of electric light and fans is fitted, a separate motor being employed for the dynamo, while the bilge pumps and winch are electrically driven. The exhaust is water-cooled throughout the whole length, and is discharged at the stern above the waterline.

Yachtsmen have not taken very kindly to the motor boat, but many of them recognize that the auxiliary engine is by no means to be despised. Accordingly, every year sees more sailing craft used for cruising fitted with small motors capable of giving a few knots in a calm. There is, as a rule, not much difficulty in finding space for the engine, but the fitting of the propeller shaft in the usual way generally entails considerable alteration of the dead wood at the stern. To obviate cutting of the stern post, etc., the Berguis Launch & Engine Company, of Glasgow, employ a system in which the propeller shaft is taken through the side of the boat as near the center as possible, a course which only entails a bush fitted into the timbers and a bracket at the stern post. The propeller is, of course, of the feathering type, to avoid resistance when the engine is not in use. The engines installed in fishing boats are also in the nature of auxiliaries, the sails being employed whenever the wind is in a favorable quarter. A typical drifter employed in the herring fishing off the east coast of Scotland is the *Sardius*. The over-all length of the *Sardius* is 80 feet and her beam is 20 feet. The engine is a 50-horsepower Thornycroft of the slow-speed type, which will run on gasoline (petrol) or kerosene (paraffin), and starting can be effected either on the former fuel or by means of a blow-lamp. With kerosene (paraffin) at 12 to 14 cents (6 to 7d.) per gallon, this boat can be run for a cost of 48 cents (2/–) per hour. For this type of work there are now many makes to choose from, and, in addition to the Thornycroft and Gardner, probably the best known, there are the Berguis, the Dan, Kromhent, Bolinders, Pasley, Passons and Mear. Other applications of the internal-combustion engine to marine purposes are legion, but those briefly described have been selected with a view to showing the many and various types of boat at present giving efficient service under all conditions in different parts of the world.

A Subsurface Torpedo Boat.

According to the *Army and Navy Journal* a new type of war vessel, provided for by Congress in the Naval Appropriation Act of last year, is to be officially tested by the United States Government at Boston. It is known as the subsurface torpedo boat, and is designed to be immune from the small gun fire now relied upon as a protection against ordinary torpedo boats. It consists of a submarine hull, which contains all the machinery and torpedo armament, suspended from an unsinkable surface hull, divided into compartments packed with cellulose. The boat has had a preliminary trial. Tams, Lemoine and Crane, the consulting architects, report that it easily made 18 knots, thus exceeding the required speed by two knots. Six tons is the weight of the vessel, and its length is 46 feet. The price which the Government has agreed to pay is $22,500. The small subsurface boats can be used either for coast defense or they can be carried on board of the larger vessels in an armored fleet. In the submarine hull is an eight-cylinder gasoline engine, of 150 horsepower. The explosive charge carried is 1,000 pounds of guncotton. A heavily armored conning tower on the surface hull, communicating with the submarine hull, enables the navigator to direct and control the boat's movements. Only two men are required on board. The inventor of the new war vessel is Clarence L. Burger, who received the degree of civil engineer from Princeton in 1885.

A Dumbarton (Ireland) firm has recently completed a new producer-gas-driven motor boat. This boat, the first of its type built on the Clyde, is a 40-foot mahogany cruiser of 30 horsepower with a speed of 10 knots. The motor is of the usual four-cylinder gasoline type, and has been specially adapted for producer gas.—*Motor Boating.*

FUEL OIL.—I.

BY E. N. PERCY.

EXTENT OF WORLD'S SUPPLY AND ITS EFFECT ON COST AS COMPARED WITH COAL.

In 1904 the world's supply, or more accurately, production of petroleum, was over 219,000,000 barrels, of which the United States produced 53.4 percent, or 117,000,000 barrels, at an average price at the well of $0.864 (3/7) per barrel. Of the United States production, California produced 25.33 percent, Texas 19 percent; but the average value was only 26 cents (1/1) per barrel, while Ohio producing 16 percent, averaged more than $1.50 (6/3) per barrel. Of the 46.58 percent produced outside of the United States, Russia averaged 35.82 percent, all other countries from 1 to 4 percent each, as follows:

	Barrels.	Percent.
Canada	492,492	.22
South America	66,200	.03
Gallicia	5,947,383	2.72
East Indies	8,008,000	3.65
Roumania	3,572,625	1.63
India	1,411,975	1.54
Germany	637,332	.30
All other countries	....	.03

By plotting these localities on a globe, remembering that the great Russian production center surrounds the Caspian Sea and vicinity of Baku, it is easy to see that the sources of oil for fuel are more accessible to the Pacific Ocean than the Atlantic; but oil can be freighted cheaper than any other fuel, since no manual labor is required in its handling in bulk from tank steamers. It is pumped to the sea coast in pipe lines wherever possible, and a pipe line crosses the Isthmus of Panama; hence, if the demand existed it could be transported as cheaply as coal to any fueling station in the world. So far as distance is concerned, it might be mentioned that California oil companies are at the present time shipping in bulk, via tank steamers, to Honolulu, Japan and China as high as 40,000 barrels a month, and lime kilns all through the Pacific Coast, at points remote from oil regions, are using upwards of 7,000 barrels per day for fuel. This fuel oil is mostly refuse from the refinery from which the more valuable products have been removed. In refining, many of these oils only give up about 7 percent of their weight in more valuable products, while other oils it does not pay to attempt to refine; while many of the Eastern oils will distill to 10 percent or less of residue, the remainder being various valuable products, hence it is easy to see that if the oil of a certain district can be refined to more valuable products, the price of fuel oil will be governed accordingly, no matter how plentiful the supply. For this reason fuel oil is more plentiful and cheaper on the Western coast of the States than the Eastern.

In 1906 there was produced in the United States 126,000,000 barrels of oil weighing, roughly, 17,000,000 tons, and 414,000,000 tons of coal. As four barrels of oil are roughly equal to a ton of coal, we could say that, in calorific value, 7 percent as much oil as coal was produced; but as the largest consumption of coal is for industrial purposes for which oil could not be substituted, or would not because of remoteness from oil districts, it is safe to assume that there is a sufficient supply for it to be delivered at a reasonable price at any seaport in the world where a steady, reliable demand exists.

United States and Russia, obviously, control the petroleum industry. In view of our immense exports of fuel oil, it is safe to assume that the United States has enough fuel oil so located that it could deliver it at a reasonable price at any port in the country. As will be shown later it is possible for a ship to carry enough oil fuel to make a round trip to any part of the world and return to a given American port, and steamships at this time carrying 14,000 tons of cargo have made the trip around the Horn from San Francisco to New York City with one original loading of oil. Other boats make the round trip to Australia and back. Taking the average price of oil at 85 cents (3/6½) per barrel, and four barrels equal to a ton of coal, we have $3.40 (14/2) per ton as the price of equivalent coal; but to this must be added the dispensing of all the firemen of a ship but one or two per watch, the ease and cheapness with which the oil can be handled and stored, and the extra cargo space it leaves for the ship. Furthermore, 65 cents (2/8½) represents the average price of the crude product, with none of the refining, as the price of actual fuel oil more nearly averages 65 cents (2/8½) delivered on the Pacific Coast in barrels or wagons, and less than this in bulk on contract. Coal which will evaporate 5 pounds of water per pound of coal is worth $1.56 (6/5½) per long ton; average coal evaporating 8 pounds of water is worth $2.48 (10/2½), and high grade rated at, say, 11 pounds water, will cost $3.40 (14/2) per ton. From this it is fair to assume that if a line of tank steamers covered the Atlantic and Pacific coasts, fuel oil could be delivered at reasonable price to any American port, and the entire American merchant marine, American navy and many foreign ships could be operated with fuel oil at less cost and with great profit to the producers.

The merchant marine would have to be educated to its use and experts advise each installation; but since America controls this industry and its cheapest transportation is by tank steamer and oil is a fuel peculiarly suited to marine work, a fleet of tank steamers for domestic and foreign service, fitted to carry part oil and part miscellaneous cargo, would go a long way towards rebuilding our merchant marine and pay well both the owners and oil producers, especially if the ship subsidy bill comes into existence.

Looking over several of the most important fields we find the average price of crude petroleum to be as follows:

California (per barrel)	$0.279 (1/2)
Colorado (per barrel)	1.152 (4/9½)
Indiana (per barrel)	1.079 (4/7)
New York (per barrel)	1.6275 (6/9)
Ohio, Eastern and Southern (per barrel)	1.625 (6/9)
Ohio, Lima (per barrel)	1.103 (4/7)
Mecca-Belden, Ohio (per barrel)	3.725 (15/6)
Pennsylvania, average (per barrel)	1.627 (6/9)
Pennsylvania, Franklin (per barrel)	4.00 (16/8)
Texas (per barrel)	.367 (1/6½)
Russia, Baku	15 kopecks per pood, or $0.78 (3/2) per barrel.
Germany, Alsace and Lorraine (per barrel)	$2.00 (8/4)
Italy, Milan (per barrel)	8.00 (1/13/4)
Rome (per barrel)	3.29 (13/9)
Japan	Varying from $1.00 (4/2) to $3.00 (12/6) per barrel.

In only a few instances, as California, is the oil used for fuel as it comes from the well, hence the above is no criterion of the price of fuel oil but is merely given to show the price of oil at or near the well or oil district.

Having located the great oil districts as lying first in Western United States, the Middle Western States, around the Caspian Sea in Russia and the East Indies, and the average prices of the crude oil at the wells, we will now investigate the price of actual fuel oil residuum delivered at the various seaboards of the world, and where it is obtainable, if at all. We will take the coasts of the three great oceans in rotation.

Pacific Coast—Obtainable only in ports between San Francisco and Los Angeles at an average price of 65 cents (2/8½) per barrel. May be obtained from tank stations in Northern ports at a higher price.

About 3,000,000 gallons a year is shipped to Alaska for steamship and industrial use, but the price, in fact the entire shipments are privately controlled. There are strong indications that a large oil deposit will be uncovered in Alaska within the next few years, which will make the Pacific Coast a stronger factor than ever in this industry. Peru is the only producing district in South America, and only equals 40 percent of what is imported from the United States, and hence there

Note.—As this article is written with special reference to marine oil-burning plants, and as many authorities have been consulted and the data rearranged for this purpose, it is only possible to give the credit due various authorities by saying in a general way that the information here is taken from Government reports, consular reports and various statistical sources, investigated and checked by the writer.

is no place on the South American coast, either side, where petroleum fuel oil may be cheaply obtained.

Hawaiian Islands—Large storage is maintained here by private interests, retailing at an average price of $1.35 (5/7½) per barrel.

Canadian Seaports—About $1.50 (6/3) per barrel.

Black Sea and East Mediterranean Ports—About $1.00 (4/2) per barrel.

The price of oil varies widely with various conditions. For instance, on the Pacific Coast, when the demand is high and the production limited, the price will go above a dollar (4/2), then several new wells will be opened, or a new pipe line finished, and the price will go down again, but it is gradually becoming more and more stable. It would not be an unlikely prediction that in a few years American ships will burn crude oil wherever desired at an average cost of $1.50 (6/3) per barrel. The 65 cent (2/8½) rate referred to for the Pacific Coast applies to delivery under contract in large quantities near the wells, or in bulk from pipe lines or steamers. Delivered at the docks in San Francisco the rate runs from 80 cents (3/4) to $1.50 (6/3). Storage stations are maintained, as stated, in Alaska, the Hawaiian Islands, and many Asiatic ports. The Hawaiian American Line steamship *Alaskan* steamed from San Francisco to New York around Cape Horn and back on one charge of oil fuel. It was all carried in the double bottoms and one large tank. Careful tests on the *Alameda,* belonging to the Oceanic Steamship Company, running from San Francisco to Australia and way ports, showed that 1 pound of petroleum did the work of 1¼ pounds of coal and occupied 40 percent less bunker space, hence if a double load of fuel were carried it would only occupy 20 percent more space than coal, and it could be stowed in the double bottoms or other extra room where it is impossible to carry coal, leaving that space for cargo, amply demonstrating that American ships could run to any port from American shores and return on American fuel. Not only would the fuel be cheaper, but most of the firemen, coal passers and trimmers are dispensed with, and the fire-room is painted up and shined just like the engine room and kept that way. The ship makes better time, as the fires are the same at all times, and never have to be cleaned; and the boilers last longer because their work is evenly applied. With a good fireman, and straight line fore and aft fire-room, one water tender and one fireman can tend any number of boilers, even for the largest ships, and the safetys will never whimper no matter how suddenly the engines shut down, for modern systems of oil burning are centrally controlled, as will be detailed later, and with the first stroke of the gong all of the main fires are out, and only a little pilot flame from a small burner in each furnace, to keep the furnace hot while standing by, and keep the auxiliaries going; even this can be shut off with a twist of the hand, but should be lighted every couple of minutes to keep the bricks red for the main burners.

Returning to the object of this particular article, the world's petroleum supply, we should remember that residuum and crude oil are used for other industrial purposes, such as road making, and the price fluctuates accordingly. California is shipping from three quarters of a million barrels per year upwards to Hawaii for fuel purposes alone. One hundred and fifty-six oil-burning steamers run out of San Francisco harbor, which does not include river boats and bay craft, among which is a fleet of the largest and most splendidly equipped ferryboats in the world. They number about twenty, and all burn oil. Some are propeller-driven and some by paddle-wheels with low-pressure boilers.

These things are mentioned merely to show the varied classes of marine work in which oil is burned, and the safety with which it can be used, as no service is more trying or risks more lives than ferry service, particularly where the boats leave and arrive on the second, and travel 12 to 15 knots in all kinds of weather.

In connection with the world's supply of fuel oil it should be distinctly understood that the greater part, possibly 60 percent of the amount, is oil, either as residuum or as crude oil that is fit for no other purpose. Bearing this in mind, together with the new fields that are being exploited, it is easy to see that fuel oil will always be available, no matter how much refining is done. In the development of new fields, outside of the great centers of United States and Russia, we find next in importance the East Indies, which produce over 3 percent of the total production. It is a very heavy asphaltum oil, and after distilling about 25 percent for refining the remainder is sold for fuel.

Important discoveries, or indications of petroleum, but comparatively little developed, exist in Newfoundland and Labrador, but no great yield exists. There is every indication of a future large petroleum yield in Mexico, there being many seepages and other indications, but none is as yet developed. There are some indications in Cuba, also. The high duty on petroleum products has compelled Cuba, up to the present time, to import crude petroleum and refine it herself; hence fuel oil is available at a reasonable price there in the form of residuum. Venezuela has a great deal of undeveloped petroleum resources, as indicated by petroleum springs, seepages, oily shales, etc., also asphalt and natural gas. Argentine formerly had enough oil to use as fuel on the railroads but the wells seem to have exhausted, and the roads have gone back to coal. Judging from the geology of petroleum, as generally found, it is hardly likely that the wells are actually exhausted, but merely in need of development. Ecuador has strong and widespread indications, but wholly undeveloped. The country of Peru produces and refines over 2,000,000 gallons of very good crude oil per year, but uses all the residuum for the railroads there and in Chili, and imports 120 percent more crude oil in bulk from the United States besides.

Austro-Hungary and Roumania produce and refine, but have many undeveloped indications. It is not out of place to say that there is no country in the world where people will gamble and take the chances in developing an oil indication like America, which accounts largely for the American petroleum industries, as many wholly undeveloped foreign fields have better indications than are found in California to-day, or ever were; furthermore, the oil fields that are developed in foreign fields, notably those in Russia, have been developed principally through the enterprise of American capitalists and firms.

Germany, while a small producer, refines her oil very highly, and through her skillful chemists secures many valuable byproducts, but fails to get down to the broad bulk ideas of handling and marketing oil. The writer has personally seen oil springs and asphalt indications, wholly undeveloped, that would cause a third-class California promoter to guarantee dividends and make market contracts for sales before he had a title to the property. If an American smells oil, or sees a splotch of axle grease he stakes out the property and inquires afterwards. Our foreign neighbors are more conservative, and unless a wealthy company takes hold of a prospect there is little chance of its development, as initiative is not so common as in America.

Italy produces about 20,000 barrels per year, but it is very high grade, and is taxed very highly, bringing its total value to $8.00 (£1 13/4) per barrel.

Large undeveloped deposits exist in Turkey, Armenia, Palestine, Africa, Siam and Persia. India is destined to become one of the greatest petroleum producers on the globe, as the indications are tremendous, but at present she produces only about 5,000,000 barrels per year, at an average price of $1.50 (6/3). China has a few wells of ancient origin, far inland, and only remote rumor gives any information, but it seems that several

grades of crude oil are in evidence; but as the indications are so plentiful elsewhere on the globe, it is probable that it exists in large quantities in various parts of China; at this time large storage stations are maintained at Hongkong and other Asiatic ports, as well as Manila and Japan.

It will thus be seen that the petroleum industry is yet young, and that fuel oil is not going to become scarce; indeed, it now awaits the demand, and fueling stations will be placed wherever it exists. Even Alaska, one-sixth the size of the States, has many indications of petroleum and soft coal. The coal fields that are now so prominently before the public in a well-known discussion are the more ancient and more highly developed carbonaceous asphalts that have hardened into soft coal. The exact geology is still a matter of discussion, but certain it is that we find the successive grades from anthracite down to lignite, peat, asphalt, tar and oil always more or less related; not necessarily near together, but always in a rough, approximate progression from the coal country into the oil country. Wherever beds of soft bitumen coal are found there, not far away, will usually be asphalt and oil; not in the same district, but not far away, and in the same general geology. Great examples of this are Pennsylvania, Russia and the Pacific Coast. The coal beds of the latter are only partially developed, but they exist, and are of immense extent, but of very poor quality, running to peat rather than lignite; therefore, in addition to petroleum seepages, etc., we may conclude, in a general way, that Alaska is destined to be an oil-bearing country, and will probably consume most of her own production.

From the standpoint of fuel oil there are two classes of petroleum as it comes from the well; they are the paraffin base and the asphaltum base. The one boils down by distillation to paraffin, the other to thick, heavy asphaltum. By paraffin is meant the material of which candles are made, not the kerosene called paraffin in England. Fuel oil as it comes from the well may be of any grade and as thin as water, or so heavy that it will not flow without special treatment. It may be light straw, brown or black. Regular fuel oil, as usually left by the refineries, flows easily, is black, with a brown tinge barely perceptible, and about 16 degrees gravity; which means, roughly, that at ordinary temperatures it will not drip off of the corner of a card. Exact characteristics and tests of the various oils will be given later, as will, also, the effect of the different properties and the kind of outfit necessary for each kind of oil.

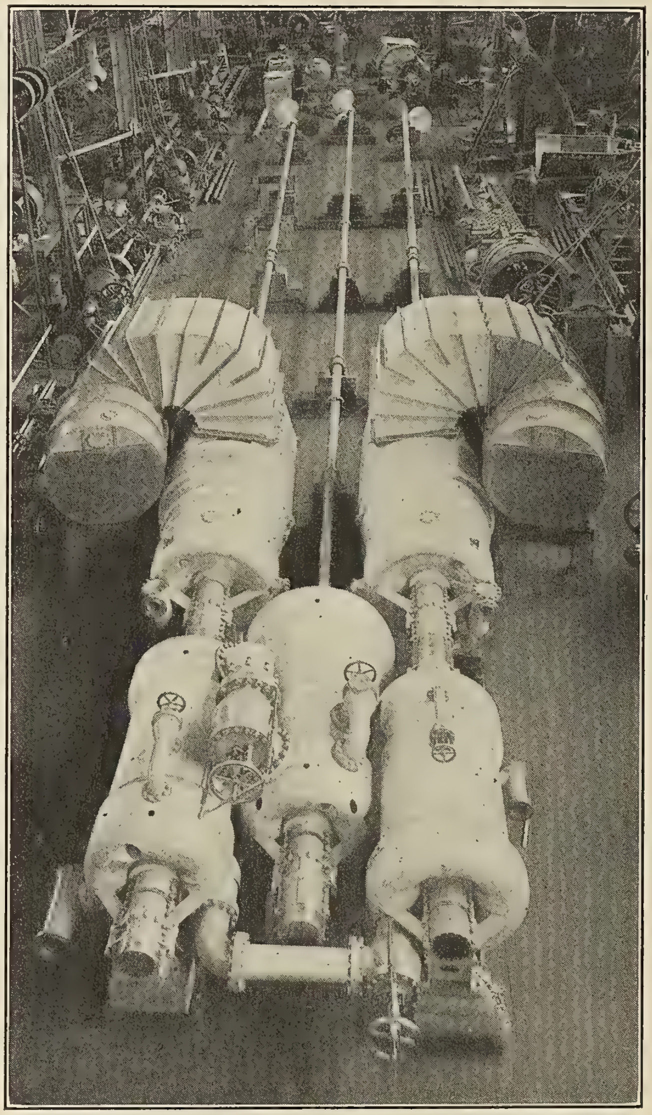
(*To be continued.*)

Turbine Machinery of the U. S. Destroyers Reid and Flusser.

A complete description of the United States destroyers *Flusser* and *Reid,* built by the Bath Iron Works, Ltd., Bath, Maine, was published in our November, 1909, issue, but we have since received a somewhat unusual photograph which shows the turbines, shafting and propellers assembled in the builders' shops. This we reproduce on this page, since it gives an unusually clear idea of the arrangement of turbine machinery for warship propulsion.

There are five turbines of the Parsons type on three shafts, the main high-pressure turbine being on the center shaft; the starboard low-pressure and intermediate-pressure cruising turbines together with the starboard backing turbines being on the starboard shaft; and the port low-pressure and backing turbine and the high-pressure cruising turbine on the port shaft. The steam piping is so arranged that any of these turbines can be run as the initial turbine. Combinations of five, four and three turbines are permissible either by disconnecting the cruising turbines or by permitting them to revolve in vacuum. For cruising at low speeds the high-pressure cruising turbine is made the initial turbine by using its throttle as a modulator. At higher moderate speeds the high-pressure cruising turbine is put out of use, and at the highest speeds the main high-pressure turbine is made the initial turbine.

Steam is furnished by four Normand return-flame boilers, designed for a working pressure of 255 pounds per square inch. These boilers are pitched forward to compensate for the squatting of the stern of the ship at high speeds. Another uncommon feature of the boilers is the length of grate, which is 8 feet 8 3/16 inches.



TURBINE MACHINERY OF THE U. S. DESTROYER REID, ASSEMBLED IN THE BUILDER'S SHOP.

The propellers are three-bladed of solid manganese bronze, the starboard and center screws being right-handed, and the port screw left-handed. The designed pitch and diameter of the propellers are respectively 58 and 63 inches.

Apropos of marine turbines, a contemporary notes that Messrs. Parsons & Company, recognizing the advantages of twin-screw propulsion, as proved in the Curtis equipment of the scout *Salem,* have developed a modified Curtis partial-admission turbine which they are to install in one of the new 5,200-ton, 26-knot British scouts. A sister ship will have Curtis turbines. The Parsons turbines will weigh 340 tons, and guarantee full power on 13 pounds of dry steam per horsepower per hour. The Curtis turbine will weigh 250 tons and guarantee 12.5 pounds of superheated steam.

A NEW FORM OF TURBINE DRIVE FOR SHIP PROPULSION.

With the announcement a few months ago of the successful results obtained by Mr. George Westinghouse with an experimental helical spur gear speed reducing mechanism, designed by Rear Admiral Melville and J. A. Macalpine, to transmit 6,000 horsepower, the practical application of this gear to a turbine-driven ship was considered to be only a matter of time. It is, therefore, of interest to know that Mr. Westinghouse has contracted with the Navy Department to furnish a turbine drive of this type for the new navy collier *No. 8*. While the details of this design of the turbines and reducing gear for the *No. 8* have not yet been approved by the Navy Department, and consequently cannot be made public, yet the general arrangement of this gear is shown in Fig. 1.

The collier is to be driven by twin screws, and the designed horsepower is 7,200. The new Westinghouse marine turbine will be used, giving in this instance an overload capacity of upwards of 8,000 horsepower. The power will be transmitted to the propeller shafts through the Melville-Macalpine speed-reducing mechanism.

THE TURBINES.

Each turbine is a complete independent unit with the high-pressure and low-pressure ahead and astern turbines in one casing. A single pipe brings the high-pressure steam to the turbine, and a single exhaust connection to the condenser suffices for the astern as well as the ahead turbine, the exhaust from both sections communicating with each other through the hollow rotor.

The high speed as compared with that of the usual marine turbines reduces the number of rows of blades necessary efficiently to utilize the energy in the steam, and the number is still further reduced by making the first and largest pressure drop through a single impulse wheel instead of through a number of rows of blades of the reaction type. When the steam has expanded to a considerable volume it is handled more efficiently by blading of the latter type; but in the earlier stages of the expansion, where the pressures are high and the volumes comparatively small, the energy is extracted with a properly designed impulse wheel just as efficiently as it could be with many rows of the Parsons type of blades. The greater compactness, due to the use of the impulse wheel, is, no doubt, a valuable feature in a turbine for use on board ship. With this construction, as now well understood, the distance between the bearings becomes short, and the rotor is consequently stiff, and vibration is thus considerably minimized. Moreover, the high-pressure steam at high temperature is confined to the nozzle chamber, so that the range of temperature and pressure to which the casing of the turbine is subjected is much reduced, and consequently there is less tendency for the casing to distort. The ahead and astern turbines have impulse elements of the same size, but in the latter the complement of reaction blading is less. The power available for going astern is, however, unusually liberal, and the economy is sacrificed in a much smaller degree than is usual in marine turbine installations. It should also be remembered that all the propellers are available for going astern, which is a decided advantage.

The impulse wheels have two sets of blade passages arranged concentrically, the outer annulus being considerably narrower than the inner. When the turbine is working at low power one or two nozzles which discharge on the outer or smaller blade ring may be opened. For greater power one or two larger nozzles may be opened to discharge against the inner or larger blade ring. When maximum power is required all of the nozzles and both blade rings are brought into action. The nozzles are so proportioned, and can be operated in so many ways, that the entire range from minimum to maximum power can be covered in convenient steps without throttling the pressure in the nozzle chamber. In other words, the full expansive energy of the steam is available even when the vessel is running at the most moderate cruising speed. Another point worthy of note is that all pipe connections are made to the lower half of the casing, thus enabling the cover to be lifted and swung back on hinges without breaking a single pipe joint. The most notable improvement, however, in the Westinghouse marine turbine is the design of the cylinder blading. It is usually necessary to remove the rotor in order that access may be had to the blades of the lower half of the cylinder.

In order to obviate lifting the rotor when inserting new blades, the American Westinghouse Company has introduced a design of cylinder blading in which the blades are mounted on flexible bronze strips instead of being calked into grooves in the cylinder. The cylinder grooves are made much wider and deeper than usual, and are slightly undercut, leaving overhanging shoulders near the top. These blade strips may be slipped into the grooves, where they cut through into the cylinder flanges, and light springs underneath hold them up against the overhanging shoulders. With this design the whole of the cylinder blading can easily be removed and

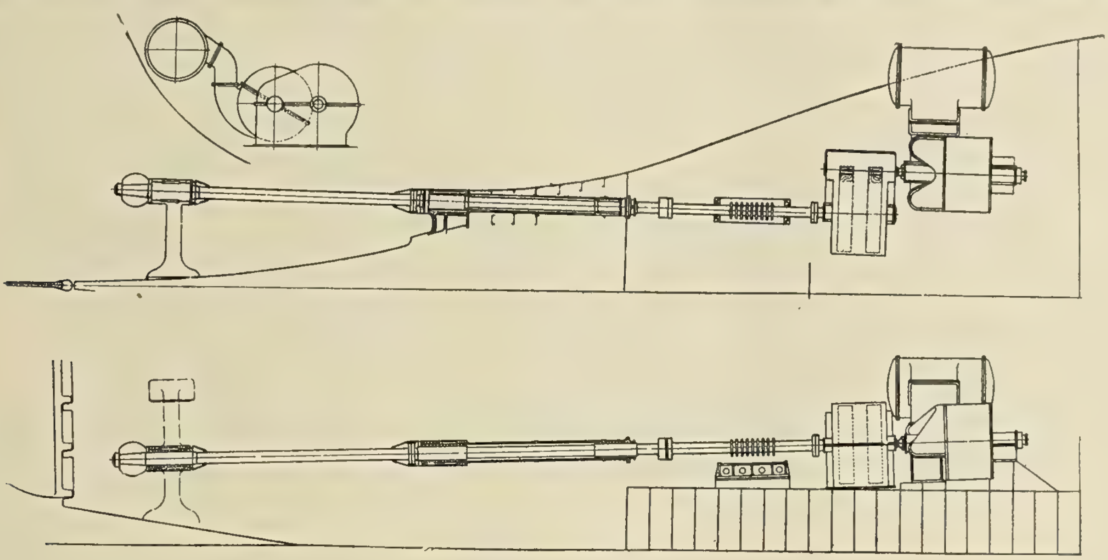


FIG. 1.—ARRANGEMENT OF TURBINE DRIVE FOR U. S. NAVY COLLIER NO. 8.

replaced without unseating the rotor. Spare blading of this kind can be stowed in a small space, and repairs could readily be made at sea. The bases of these blading strips are extended on one side, so that they project over the tips of the corresponding row of blades in the rotor, forming what is practically a removable bronze lining for the cast iron cylinder. As the blade strips are backed up by flexible springs, the clearances between the tips of the blades and the cylinder, or the rotor, may be reduced to a value that would be impossible with rigidly inserted blades. It has been found practicable to assemble the turbine with the blade tips in actual contact with the base strips and the rotor, and to allow the clearance to adjust itself by actual wear.

There are two independent valves on each unit, one for the ahead turbine and one for the astern turbine. These valves are operated by levers, and are so designed that a continuous movement of either operating lever from the closed position successively opens all the different combinations of nozzles, admitting the steam in constantly increasing quantities until the maximum power is attained.

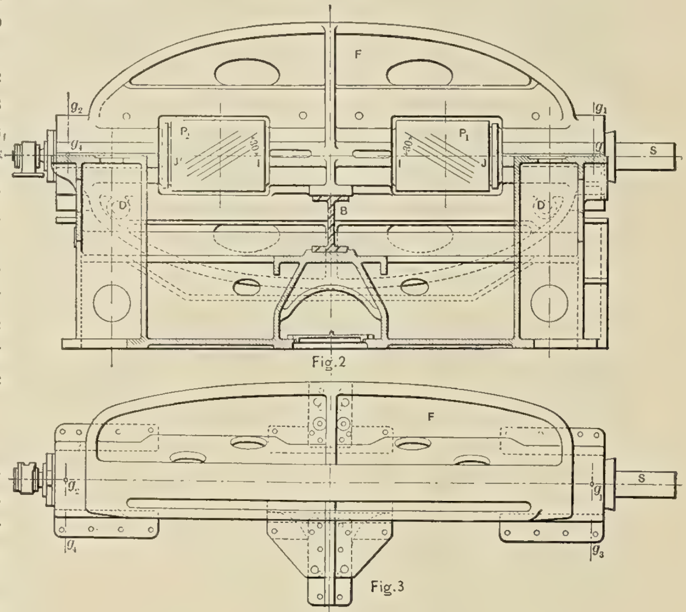
While the turbine may be manually controlled by the engineer in accordance with instructions conveyed by the ordinary ship telegraph, it is possible to control it directly from the bridge, or from any one of several points on the vessel, by means of an electro-pneumatic operating gear working on the throttle valve levers.

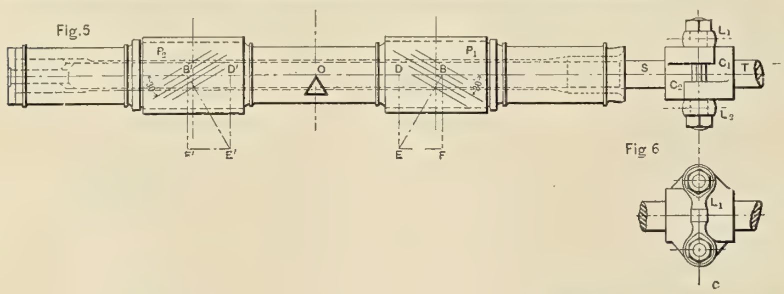
THE SPEED REDUCTION GEAR.

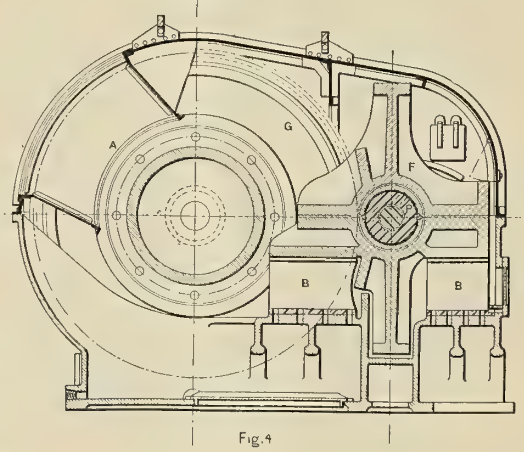
The speed reduction gear can best be described by the following abstract from an article published in *Engineering*, describing the design and construction of an experimental gear designed to transmit 6,000 horsepower at 1,500 revolutions of the pinion per minute, the reduction ratio being about 5 to 1. A perspective view of the gear with the casing partly broken away is shown in Fig. 7. In this case the device is coupled to a Westinghouse double-flow turbine.

The pinions have 35 teeth each and the spur-wheels 176, a hunting-cog being introduced to equalize wear. The pitch is 1¼ inches, and the pitch helices are at an angle of 30 degrees with the axis of the shaft. One wheel and pinion have, of course, right-handed helices, and the other pair left-handed, so as to eliminate end-thrust. The diameter of the pitch circle of the large wheels is about 70 inches, and of the pinions 14 inches. Details of the gear-box are shown in Figs. 2, 3 and 4. These have been designed after a long and comprehensive study of the circumstances which tend to interfere with the proper working of very broad teeth. A small pitch was deemed essential if a reasonable absence of noise was to be secured, and this necessarily meant broad teeth, in view of the fact that 6,000 horsepower was to be transmitted with a pitch-line speed of very nearly 100 feet per second, and with a limiting pressure of 453 pounds per lineal inch on the teeth.

In order to ensure the proper working of such broad teeth, Messrs. Melville and Macalpine have adopted the plan of mounting the pinion shaft in a device which they have dubbed a "floating frame," the object of which is to cause the alignment and position of this shaft to be controlled wholly by the interaction of the teeth in contact, and not by the greater or lesser skill of the workman in laying out and fitting the bearings, which, moreover, even if exactly right to start with, could not be depended on to maintain permanently their alignment. The "floating frame," which is lettered *F* in Figs. 2 to 4, is a heavy steel casting flexibly mounted in the gear-box and supporting in rigid bearings the pinion shaft, but in such a way as to allow of this shaft having a slight longitudinal freedom, so that it can slide axially to and fro within the frame.







DETAILS OF REDUCTION GEAR.

Fig. 2 is an elevation of the floating frame showing the flexible I-beams *B*, on which it is supported from the bed-plate. The pinion, it will be seen, is supported in three bearings, the center bearing dividing the tooth faces P_1 and P_2, of which P_1 is right-handed and P_2 left-handed. The large gear, being much stiffer, requires only two bearings. The floating frame is made very deep vertically, so as to be exceedingly stiff to withstand deflection by the nearly vertical forces at the bearings. It is also amply stiffened in the horizontal plane to obviate deflection from the weaker horizontal forces. The floating frame is shown in plan in Fig. 3, while Fig. 5 shows the pinion shaft and the flexible shaft *S* by which it is driven. At the end of this shaft is a coupling *C* driven by the turbine-shaft *T*. The axes of the gear and pinion are horizontal and parallel to one another when everything is in correct adjustment. But it will be evident that the I-beams *B* are virtually a hinge, and if the large gear *G* was not in place, or the coupling *C* connected, the axis of the float-

ing frame and pinion could easily be deflected in the vertical plane through a small angle by a slight flexure of the webs.

The coupling consists of two flanges C_1 and C_2, mounted on the shafts T and S, and connected by two transverse links L_1 and L_2, and by a center pintle, care being taken not to make this restraint redundant. The shaft T can, therefore, only rotate the shaft S through the links L_1, L_2, but as these are transverse, no longitudinal forces can be transmitted. Even when seriously out of adjustment, the longitudinal forces are so small as to be negligible. The pinion, therefore, has perfect freedom of longitudinal movement in its bearings. Further, the pinion is driven by the shaft S, which passes completely through it to the end distant from the coupling, where it is keyed and bolted. This shaft is so flexible that it imposes practically no constraint on the pinion and floating frame such as would prevent slight angular yield of the I-beams B. It is evident, therefore, that, both as to its longitudinal position in the floating frame and in the angular position of its axis, the pinion is solely under the control of the forces transmitted by the teeth of the large gear.

Neglecting the very slight friction of the well-lubricated teeth, the total forces at the tooth contacts, indicated by B, E and B^1, E^1, Fig. 5, will be nearly at right angles to the teeth at B and B^1; that is, they will be at 30 degrees to the vertical. Hence the two parallelograms of forces shown will be similar. Now the horizontal forces at $B\ D$, $B^1\ D^1$ are the only axial forces acting on the pinion. If these are not equal, the pinion will at once shift longitudinally, which it is free to do, till they are equal. The two parallelograms of forces then become equal to one another in every respect, and the vertical force $B\ F$ is equal to the vertical force $B^1\ F^1$. But besides this longitudinal movement of the pinion, the frame in which it is mounted is free to rotate about the center point O by flexing the I-beams. Hence it follows that the moment of the vertical force $B\ F$ about O must be equal to that of $B^1\ F^1$ about the same point; and as $B\ F = B^1\ F^1$, the arms of these levers $O\ B$ and $O\ B^1$ must be equal. Thus it is claimed that not only will the total forces on the teeth P_1 and P_2 be equal, but the distribution will be so similar that the centers of pressure B and B^1 will be similarly placed.

This, it is contended, practically assures a good distribution of pressure under all conditions of load. For, by sufficient running of the gear, it may readily be assured for one particular load; and if the pinion and floating frame are made sufficiently stiff, this condition will not be seriously changed by increase or decrease of load. The strength of both pinion and floating frame is far in excess of that requisite to sustain the maximum forces to which they will be subject, and then dimensions were made such as to give ample rigidity. For instance, under full load the flexure of the cast steel floating frame in the vertical plane is so slight that the end bearings will be lowered relatively to the center by not more than 1-2,000 inch.

There is, moreover, a certain compensation for this deflection, owing to the action of the lubricant. When the load on the gear is increased, the end-bearings will be forced down, bending the pinion and making the teeth bear harder at the inner ends I and I^1. Thus more than the proper force will be exerted on the center bearing, and less on the outer bearings. This will at once lead to a thinning of the oil-film on the center bearing, and to its thickening on the outer bearings. As the total thickness of the oil-film is more than twice the yield of the outer bearings, this change in the thickness of the film will go far to compensate for the elasticity of the floating frame.

Given that the axes of the gears are parallel to start with, the action of the teeth will, it is claimed, force the axis of the pinion into exact alignment with that of the large gear, provided that in the flexure of the I-beams supporting the floating frame the pinion shaft tilts in a vertical plane parallel to that containing the axis of the large gear. If there were no floating frame, and all bearings of the pinion and gear were cast in one bed-plate, the longitudinal dimensions remaining unchanged, an error of alignment of the axes in the vertical plane not exceeding 1-1,000 inch in the length over the bearings would entirely upset the uniform distribution of the pressure along the faces of the teeth. Hence, with the most careful work, the above assumptions may not be fulfilled with sufficient accuracy. Even if they were exactly fulfilled when the gear was first completed, inequality of the side wear of the bearings might cause the axes to stand at a sensible angle in the horizontal plane. Provision is made for measuring such errors of alignment.

As to the effects of the elastic strains of the teeth and shafting, steel gears of 1¼-inch pitch are commonly run under a load of 1,000 pounds per inch of tooth face at ordinary pitch-line speeds. As all gears are liable to errors of alignment, this average pressure actually means that at times there will be a maximum pressure very much greater. In the gear under discussion the highest mean value used is less than 500 pounds per inch of tooth contact. Suppose then that by errors of alignment the actual value varied from zero to 1,000 pounds per inch, which is far within the disturbance occurring in ordinary gears. It may be shown that the yield of these teeth under 1,000 pounds per inch is such that the distribution of pressure would close up an opening of contact of nearly 1-1,000 inch. Errors of erection will be exceedingly minute, so that the only errors to be avoided are those due to

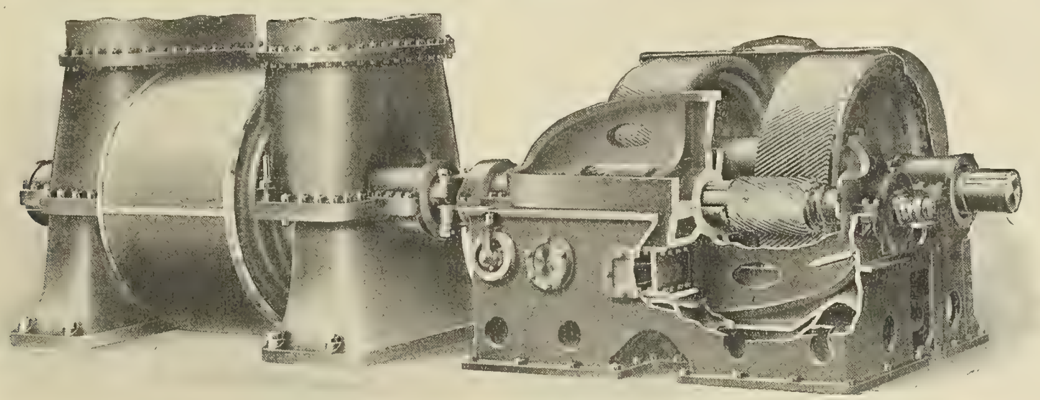


FIG. 7.—MELVILLE AND MACALPINE'S REDUCTION GEAR CONNECTED TO WESTINGHOUSE TURBINE

unequal horizontal wear of the bearings. Any unequal vertical wear will be compensated for by slight tilt of the floating frame. As the forces on the floating frame are inclined to the vertical at only a small angle, vertical wear will take place much more quickly than horizontal; and as the inequality of the wear will usually be but a small fraction of the total wear, it would be almost impossible for any very sensible angular error in the horizontal alignment, such as assumed above, to creep in before the bearings were worn down a long way vertically, and ready for renewal.

Involute teeth have been used, as they give excellent results. But they have also the well-known property that if, through wear of the bearings or errors in the original setting up, the axes are somewhat farther apart than designed, the teeth still run true, and there is no "opening of contact." This does not hold with any other form of teeth. Hence the solution presented by the floating frame with involute teeth is unique.

From the foregoing it will be seen that the elasticity of the I-beams allows freedom of movement of the axis of the pinion and floating frame in the vertical plane. But by warping the webs of these beams the axis of the floating frame might also turn slightly in the horizontal plane. It is, of course, many times more rigidly mounted against this displacement than against that in the vertical plane, but still the rigidity is by no means complete. It may appear that this is not specially important, as an angular displacement in the horizontal plane, even if of measurable amount, causes no important disturbance. But that is not the only consideration, as the question then arose as to whether with freedom of rotation both in the vertical and horizontal planes the position of the axis of the floating frame would be stable or unstable; that is to say, if forcibly displaced from exact alignment to a small angle in the horizontal plane, will the forces at the tooth contacts tend to bring it back to perfect alignment or to further displace it? By consideration of the slight changes of direction of the forces at the tooth contacts produced by such displacement, it can readily be shown that, with involute teeth, the position of the axis of the floating frame is unstable, and a slight displacement arising from any cause will tend to increase. With the I-beams alone, therefore, there might arise excessive horizontal errors of alignment, and trifling causes might produce sudden and violent changes of the horizontal error, either of which effects would endanger the whole mechanism. The floating frame has therefore been deprived of all freedom of motion in the horizontal plane by means of two horizontal struts standing transversely between the floating frame and bed-plate. Obviously these struts in no way interfere with the freedom of movement of the floating frame in the vertical plane. Where they bear in the bed-plate there is an adjusting and locking mechanism which greatly facilitates the true setting up of the floating frame, and is to be seen in the perspective view in the front of the bed-plate, near the end next the turbine.

The only condition which could cause serious disturbance of the tooth pressures is an excessive heating of the pinion above the temperature of the gear. But the design provides for a copious application of lubricating and cooling oil, especially to the pinion, which has most tendency to heat. The cover, also, is so arranged as to draw in air at the ends at A, Fig. 4, by the fan action of the gears, and discharge it by openings (not shown) to the right of this cross-section. Besides, water can be circulated, by means only partly shown in the figures, between the pinion and the flexible shaft S.

At 1,500 revolutions per minute of pinion and 453 pounds per inch of tooth contact, the gear will transmit 6,000 horsepower. The pitch-line speed would then be 5,500 feet per minute, and the mean speed of sliding about one-tenth this, or 550 feet per minute.

Similar gears could be applied to any speed of ship. This design would then be of the correct power for the *Dreadnought*, and applied to her, it is claimed, would save fully 50 percent of the weight of her turbines, besides reducing boiler weights, since both turbines and propellers would now be of considerably enhanced efficiency.

Increasing, by the law of comparison for similar machines, the dimensions and power of the present design, from 6,000 horsepower, a size is obtained suitable for the *Mauretania* with three large screws of the same total power as the present four-screw ship. Here, again, the weight of the turbines would, it is claimed, be halved, as also the engine-room length. The boilers also, as in the *Dreadnought*, would, it is considered, be materially reduced.

In Fig. 8 the upper views represent the *Mauretania* thus modified, as compared with the existing arrangement shown in the lowest of the three views. For warships the saving effected by such a gear should, it is claimed, be considerable, especially at cruising speeds. The *Mauretania* is supposed to be capable of developing 70,000 shaft horsepower. Even the comparatively low speed at which these turbines run is too high for maximum propeller efficiency. It is hardly possible, it is estimated, that the propeller efficiency exceeds 55 percent, which means that the actual effective propelling power is only about 38,500 horsepower. At a lower speed of revolution, well within the capabilities of the reduction gear, it is claimed that a propeller could be made that would have an efficiency of not less than 65 percent. With this improved efficiency, the shaft horsepower required for the same effective propelling power would be somewhat less than 57,000, a saving of almost 15 percent. This means that without sacrificing in the smallest degree the remarkable speed of these vessels, the boiler equipment could be reduced about one-seventh, as well as the amount of coal burnt on each voyage. This would obviously not only result in a very marked saving in capital investment and operating expenses, but would add many tons to the cargo-carrying capacity and add considerably to the earning power. But, it is contended, this estimate, large as it is, is still too modest. With the turbines and propellers direct connected so that they both revolve at the same speed, not only is it necessary to sacrifice the efficiency of the propeller but the efficiency of the turbine as well. For equal efficiencies in any two turbines the number of rows of blades is, roughly speaking, inversely proportional to the square of the respective peripheral speeds of the rotating elements. The peripheral speed of the rotating elements in the turbines of the *Mauretania* and *Lusitania* is only about one-third of the speed common in large turbines used on land. This would mean that to obtain the efficiencies common to the latter the former would require approximately nine times as many rows of blades, which would make a machine of prohibitive length. To maintain the same speed of revolution and increase the peripheral speed of the turbines of these vessels to the point common in land practice, the rotors would have to be nearly 40 feet in diameter, which is manifestly beyond the shadow of possibility.

It is believed that the steam consumption of the turbines of the *Mauretania* and *Lusitania* cannot be less than 14.5 pounds per shaft horsepower per hour, while it has been demonstrated that turbines of similar capacity, operating at speeds which the reduction gear makes possible for marine service, the steam consumption does not exceed 11 pounds per shaft horsepower per hour. This means that the boiler capacity could be further reduced from the first estimate of 60,000 horsepower to about 45,000 horsepower; and it is claimed the over-all efficiency of the installation would be sufficiently improved to result in a reduction of over 35 percent in the coal consumption. It has been reported that the coal consumption of these vessels is 4,700 tons per voyage. Taking coal at $3.25 (13/6.5) per ton, the saving in coal alone would be $5,300 (£1,060) per

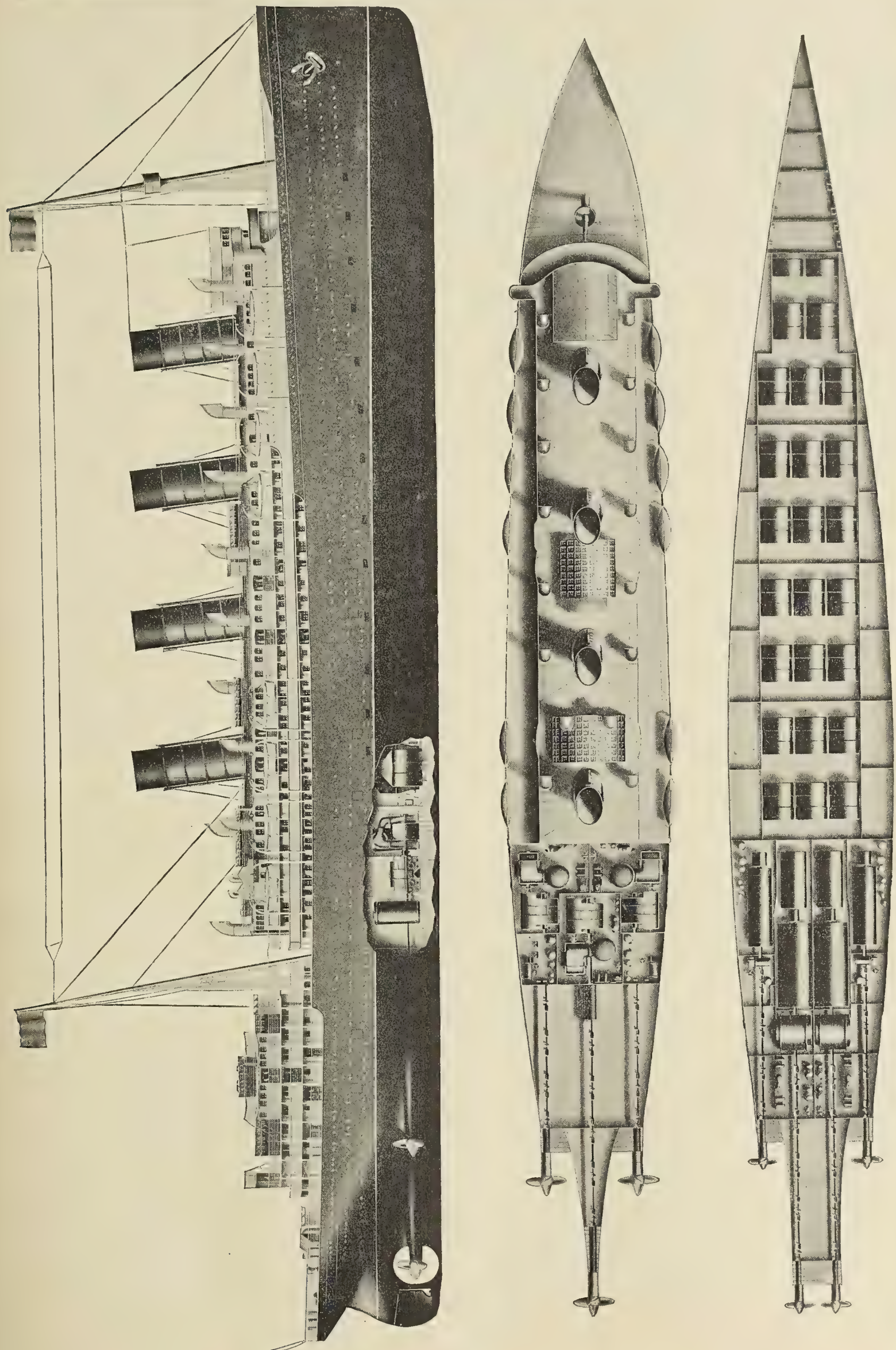


FIG. 8.—DIAGRAM ILLUSTRATIVE OF RELATIVE SPACES OCCUPIED BY GEARED AND DIRECT-DRIVING TURBINES IN S.S. MAURETANIA.

voyage, to say nothing of the smaller cost of wages. The increased cargo capacity resulting not only from a reduction of over 1,600 tons in coal, but also from the greatly reduced weight of the equipment and the space necessary for it, is an asset the value of which is difficult to estimate. A great deal more might be said about the advantages which his gear is claimed to have, but the above is sufficient to show that they are by no means negligible.

RESULTS OF TESTS.

The experimental gear was tested by means of a specially designed hydraulic absorption dynamometer, by means of which the measurement of the power output of the gear was accurately obtained. To measure the power input it was necessary to determine accurately the horsepower of the turbine. This was done by taking advantage of the fact that as long as the speed and exhaust pressure are maintained constant the absolute inlet pressure of commercial dry steam at any instant is a very accurate measure of the brake horsepower the turbine is developing. By substituting for the reduction gear a dynamometer connected directly to the turbine shaft, and operating the turbine at a fixed speed and with a constant vacuum in the exhaust pipe, the inlet pressures corresponding to different loads at this speed were determined, and the turbine thus calibrated. A check on this method of determining the power input to the gear was afforded by the measurement of the heat appearing in the oil used for lubricating the gear. Of course, the loss of power in its transmission by the gear appears as heat in the oil, and this can be determined with a degree of accuracy, the only source of error being the heat radiated from the gear casing and from the oil piping.

By these methods the efficiencies of the gear when transmitting different quantities of power were found to be consistent and uniform, ranging from 98.5 to 99 percent.

Dutch Marine Suction-Gas Plants.

BY F. MULLER VAN BRAKEL.

The financial calculations in the November issue on working cost of marine suction-gas installations, as compared with oil and steam plants, close with tables showing the yearly costs of different-sized ships and engine plants. The yearly costs for the ships have no influence on the comparison, and might have been omitted so far as it concerns this point. They are only given to show the financial influence of the ship relatively to the costs of engine and fuel. To get at the total yearly costs, wages and harbor duties should be added. For the 120-ton boat this would be: Skipper, $400; 1 man and 1 boy, $325; harbor duties, $30; total outlay for ship, $598 + $400 + $325 + $30 = $1,353. For the 300-ton ship the total yearly outlay would be: Skipper, $400; mate, $250; 2 men and 1 boy, $525; harbor duties, $70; depreciation, etc., $1,092; total, $2,337.

To compare gas with steam or oil it suffices to give the total outlays for engine and fuel. It should be observed that the 120-ton gas motor boat has a disadvantage of 3½ tons cargo capacity against the oil-motor boat, while the 300-ton gas boats have an advantage of 17 tons against the steam boats. For the greatest part differences originate in the producer installation weights for the 120-ton boats, and in the smaller quantity of fuel necessary for 100 hours' steam.

The loss caused by this decrease of cargo-carrying capacity may be expressed in dollars, the assumption being made for this case, as for all former calculations, that the ships are plying in Dutch waters, under conditions of freight and prices usual in Holland. The mean length of voyage is taken to be fifty hours, giving $1 freight per ton, as is the case in several trades. The 120-ton gas boat loses 3½ tons = $3.50 per voyage = $7 per 100 hours. The 300-ton steamship loses 17 tons = $17 per voyage = $34 per 100 hours. These losses should be added to the working costs, which gives the following results:

116-TON GAS BOAT VS. 120-TON OIL BOAT.

Yearly Cost for	1,100 Hours Yearly. Gas.	Oil.	1,800 Hours Yearly. Gas.	Oil.
Engine	$460	$244	$513	$275
Fuel	110	477	178	780
Cargo loss	77	...	126	...
Total outlay.	$647	$721	$817	$1,055

823-TON GAS BOAT VS. 300-TON STEAMER.

Yearly Cost for	1,100 Hours Yearly. Gas.	Steam.	1,800 Hours. Gas.	Steam.	3,000 Hours. Gas.	Steam.
Engine	$1,569	$1,095	$1,569	$1,095	$1,569	$1,095
Fuel	300	590	510	965	850	1,610
Cargo loss	....	374	....	612	....	1,020
Total outlay....	$1,879	$2,059	$2,079	$2,672	$2,419	$3,725

It will be seen that the result is depending to a great degree on conditions of yearly sailing, hours, full prices, etc. To judge on the advisability of fitting gas, steam or oil engines in a given ship for a given trade, an exact calculation should be made, taking into consideration the following points: Fuel consumption, fuel prices, yearly sailing hours, engine prices, freights and engine weights.

HYDROGEN IN THE GAS MIXTURE.

From the editorial comment in the October issue it appears that some American engineers are not convinced of the advantage of introducing hydrogen into the gas mixture of suction gas plants.

First of all may be pointed out the practice in Germany, as in no country has the suction-gas industry developed to such an extent. The fact is that, without any exception, the general practice is to introduce hydrogen into the mixture.

A well-known authority on these questions may be quoted, viz.: Hugo Güldner, author of that unique work *Das Entwerfen und Berechnen von Verbrumingo motoren.* On pages 518, 519, 533 and 586 he writes:

"In the power gases carbonic oxide and hydrogen are the real combustible elements. For the motoric combustion both of them have good and bad qualities, which should neutralize each other in the mixture. The question: Does the motor manufacturer want more CO or more H_2 in the gas mixture? is answered by Kutzbach in the following way: (*Zeitschrift des Vereines Deutscher Ingeneure,* 1905, page 238.)

"Hydrogen, when compared to carbonic oxide, appears to have the following qualities:

"1. Its igniting temperature is considerably lower.

"2. Its igniting velocity is thirty times as great.

"3. It mixes with the air more rapidly.

"4. It will still burn in an abundance of air where CO will not burn any more."

The presence of H, therefore, decides on the form of the diagram and on the highest allowable temperature of the cylinder liner; small variations in the quantity of H are of great influence on the igniting velocity and so on the motor power. The motor manufacturer, therefore, says: "Not too much H, to prevent the engine getting too sensitive; not too little H, to assist the slow CO, which will occasionally burn so slowly as to give diagrams of triangular form. Sometimes it is still burning when the exhaust is done and new gas is admitted, igniting this and thus causing violent explosions.

Power gases from coke and anthracite, respectively, are constituted as follows: (E. Meyer, *Zeuitscr. d. V. D. T.,* 1895, page 1540; 1896, pages 1239 and 1304.)

PERCENTAGES OF THE VOLUME.

	Coke.	Anthracite.
CO	27.6	16.6
H	7	24.2
CO_2	4.8	11.3
CH_4	4	2
N	58.6	45.9
	100	100

The heating power of these different elements in 1 cubic

meter (35 cubic feet) of anthracite gas of a commonly-used mixture is as follows:

	Percentage of the Volume.	Calories.	Percentage of the Heating Power.
CO	23	700	56
H	18	465	37.2
CO_2	6	0	....
CH_4	1	85	6.8
N	52	0	....
	100	1,250	100

Apparently the hydrogen has a great influence on the heating power of the gas, especially in anthracite gas; which may contain as much as 24 percent H, more than half the heating power may be given by the hydrogen.

Thus it is *theoretically* proven that it is advantageous to introduce a great quantity of steam into the producer. *Practically* it is profitable, too, because it prevents the baking of slags and the burning through of the internal-firing apparatus.

Too high a percentage of H, however, causes violent explosions in the cylinder. Very few motors can endure 15 to 20 percent H in the gas; that is, 7 to 10 percent in the gas-and-air mixture which enters the cylinder; usually a troublesome knocking begins at 10 percent H in the gas. Moreover, the reduction of H_2O to H_2 and O_2 takes a good deal of heat, which means a decrease in temperature in the producer, thus favoring the forming of CO_2 at the cost of CO. Higher percentage of H_2 thus always means more CO_2 and less CO, which may be seen, too, from the table above.

The best plan for every individual motor is to give as much water to the producer as the motor will endure.

The objection that the burning of H_2 to H_2O in the cylinder may form drops of water that may settle on the igniter, and so prevent the ignition, is answered best by pointing to the fact that H_2O formed always leaves the cylinder as steam. (Güldner, page 580.) Only when the cylinder liner is still cold at starting might water condense on the igniter. To prevent this the motor should be started on gas without hydrogen, and only when the motor has been going for some time should the water and steam cocks leading to the producer be opened.

Institution of Naval Architects.

The 1910 session of the Institution of Naval Architects was held in the hall of the Royal Society of Arts, John street, Adelphi, March 16, 17 and 18. The following papers were read and discussed:

MARCH 16.

"The Battleship of the Future," by Rear Admiral R. H. Bacon, D. S. O., C. V. O. Associate.

"Report on the Progress of the National Experimental Tank," by R. T. Glazebrook, D. Sc. F. R. S.

"An Account of the Society for the Improvement of Naval Architects," by A. W. Jones, R. C. N. C. Member.

MARCH 17 (MORNING SESSION).

"Experimental Investigations of Weight and Thrust Deduction Values," by W. J. Luke. Member of Council.

"Some Considerations Regarding the Phenomena of Propulsion," by Prof. J. B. Henderson, D. Sc.

"Model Screw Propeller Results: a Comparison," by T. B. Abell, R. C. N. C.

"A New Method of Ascertaining the Weight of Cargoes on Board Ship," by A. Murray. Member.

EVENING SESSION.

"Motor Life Boats of the Royal National Lifeboat Institution," by J. R. Barnett. Member.

"The Application of Internal Combustion Engines to Fishing Boats and Other Commercial Launches," by Linton Hope. Associate.

"The Substitution of the Electric Motor for Marine Propulsion," by W. P. Durtnall.

MARCH 18.

"The Application of the Marine Steam Turbine and Mechanical Gearing to Merchant Ships," by Hon. C. A. Parsons, C. B. F. R. S., D. Sc. Vice-president.

"Note on the Measurement of Shaft Horsepower," by Prof. B. Hopkinson, M. A. D. Sc. Associate.

"The Brittleness of Mild Steel Due to Nitrogen," by C. E. Stromeyer. Member of Council.

Lubrication of Marine Steam Engines.

In one of the recent issues, a correspondent wonders how marine engines can be run without cylinder oil and not injure the cylinder walls or piston packing.

There is not a boat in the United States navy, from the battleship down to the 30-foot launch, that uses cylinder oil or compound, direct to the cylinder or valve chamber, either in the main engines, or auxiliaries, ventilating, force-draft, reversing. The piston rods on the main engines are swabbed at regular intervals, not with the idea of getting oil into the cylinder, but to save the packing in the stuffing-box and keep the rods tight. When a ship anchors for over a week in port, it is customary to remove cylinder heads and valve-chest covers, and swab the bearing surfaces with vaseline.

If the main engines are fitted with D-slide valves, of the ordinary or double-ported type, they are, as a rule, if large and heavy, connected to a balanced piston on top. This balance chamber is practically an inverted dashpot, with the bottom of the piston exposed to the atmosphere, whereas the clearance on top of the piston is connected to the condenser. The average vacuum carried is 26 inches. This balanced chamber is designed large enough to remove the "dead" weight from the eccentrics and link block.

To reduce the excessive friction on the valve space, with this type of valve, there is fitted on the back of the valve a brass or composition ring, secured in such a manner as to be steam-tight on the back of the valve at all times. The inside of the ring is connected to the condenser by a small pipe. In the United States navy, steam, in itself, is sufficient lubrication for internal wearing surfaces.—F. Caldwell in *Power and the Engineer*.

New Steamers in New York Harbor.

The Walters-Colver Company, West Brighton, Staten Island, N. Y., have on their building ways two new steamers for the City of New York, Department of Correction. The hull of the *Riker Island*, the first of these two, is about completed, and the launching will take place shortly. The *Riker Island* will be a wooden vessel throughout, 81 feet on deck, 75 feet 10 inches on loadline, 20 feet beam and 8 feet depth of hold. She will have a draft of 5 feet, and develop a speed of 12 miles an hour. This steamer will be equipped with a flue and return-tubular boiler, carrying 150 pounds pressure per square inch; a vertical inverted compound surface condensing engine, with cylinders 9 inches by 20 inches diameter by 16 inches stroke, designed to develop 225 horsepower. The vessel will be lighted throughout with electricity.

The second steamer is to be called the *Hartz Island;* length on deck 72 feet, on loadline 65 feet, width 17 feet, and depth of hold 8 feet, with a draft of 4 feet 6 inches. She is designed to develop a speed of 12 miles an hour. Her boiler and engine will be similar to those of the *Riker Island*, but somewhat smaller, and designed to develop 150 horsepower. Both the *Riker Island* and the *Hartz Island* are to be used for passenger and freight service between the various institutions connected with the Department of Correction.

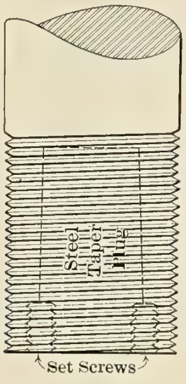
PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries Breakdowns at Sea and Repairs.

Repairs to a High-Pressure Piston Rod.

On Oct. 19, 1909, the U. S. S. *Annapolis* returned to port after a hard run in a gale with heavy seas, and a heavy knock developed in the high-pressure engine. Upon investigation it was found that the threaded end of the high-pressure piston rod, which screwed into the cross-head, had become so loose and worn that it could not be made tight again by the clamping bolts. As there was no spare rod available, the following repairs were made (see sketch).

A taper hole having been bored in the end of the piston rod to nearly the entire depth of the thread, a finished steel plug of the same taper was fitted to within 1½ inches of the bottom of the hole. This plug was a few inches longer than the depth



THREADED PORTION OF PISTON ROD WITH TAPER PLUG INSERTED.

of the hole to facilitate its extraction. The rod was now heated slightly over a charcoal fire and the plug driven home. This expanded the threaded end of the rod 1/32 inch.

Having extracted the first plug, a second plug finished to the new taper in the rod was fitted to within 1½ inches of the bottom of the hole and again driven home and allowed to remain in place while the rod was cooling. This plug was then faced off and secured by two set screws. The second operation expanded the rod another 1/32 inch, so that the diameter of the rod was now increased 1/16 inch, which was found sufficient to refit the thread and make it tight in the cross-head.

After the repaired rod was installed, work was commenced at once to manufacture a new high-pressure piston rod. A bar of machinery steel 6¼ inches in diameter was used. A piece 4 feet 6 inches long was hack-sawed off, put in the lathe on board the ship and a new rod was successfully turned down, tapered and threaded ready for use by the ship's force in 64 hours.

John F. Green,
Tutuila, Samoa. Machinist, U. S. N.

Loss of Vacuum in a Marine Condenser.

The usual causes which lead to a loss of vacuum in a condensing engine are well known to the ordinary marine engineer, and the most usual points to which he is accustomed to look in the event of a partial or total failure of vacuum are leaky cylinder glands, broken air-pump valves, broken circulating pump valves, cracked castings, which allow air to enter into the condenser, and leaky joints between the condenser and pumps. These and other causes produce by far the greatest number of failures of vacuum, and their treatment is a matter of standard practice.

It has, however, been known that engineers have occasionally had a greatly reduced vacuum and have naturally gone over all the above defects without finding anything wrong. It may be worth pointing out that such failures sometimes occur through deterioration in the condenser itself. As a last resource it is advisable to examine the division plate in the water-box of the condenser, as it is sometimes found that this has been partly or wholly carried away, and consequently the water, instead of passing through the tubes, goes straight through the water-box from inlet to outlet, and therefore the tubes of the condenser are surrounded by stagnant water, which rapidly becomes so hot as to have no effect upon the steam passing.

This trouble is, of course, a rather serious matter, but a temporary repair can very easily be accomplished by fixing and shoring a wooden division plate made of a plank of soft wood about 2 inches thick and a length equal to the horizontal width of the interior of the water-box at the point where the division plate should be. It will be found that by firmly choking this in the first instance the water will cause it to swell and make it fit tighter, if anything, than ever before. This repair is, as a matter of fact, sufficiently good to be permanent, as the duration of life of wood under such circumstances is long. It is advisable, however, to obtain a new condenser cover with a new division plate at the end of the voyage. The repair is, however, worth mentioning, as it only takes at the outside 30 minutes to effect it, and it will give no further trouble throughout the voyage.

Glasgow. Bert Hall.

Crosshead Troubles.

The crosshead shoes of marine engines do not give much trouble, and when the rubbing surfaces are well lubricated they do not require much attention. Formerly crossheads were usually provided with brass shoes, but now, as a rule, the slippers are of cast steel, lined with white metal, which is quite satisfactory, though good results may also be obtained when the shoes are of cast iron, thus making both of the rubbing surfaces cast iron. The latter arrangement requires more oil than white metal on cast iron, but it wears less. Frequently, however, cast iron will give trouble where white metal will not, as evidenced by the following incident:

The crossheads of the compound engine of the steamer *W* were constructed as shown in Fig. 1, the cast-iron shoes running on cast iron guide plates. On the trial trip the crosshead warmed up, as too little oil was used on the rubbing surfaces. It was found impossible to cool the crosshead by using as a lubricant oil mixed with white lead, which is usually found an excellent help when a bearing or sliding surface is heated. The crosshead soon became so hot that sparks could be seen on the guide plates, and, after some revolu-

* We pay for these articles.

tions, the engines stopped entirely. It was found necessary to take off the shoes, which proved a rather laborious job, since it was necessary to take the cylinder cover off and unscrew the piston, in order to lower the rod below the sliding plate, so that the screws which fastened the shoes could be loosened. After this was done several hard places were visible on the shoes and these were cut away. Subsequently everything was put back in place and the engine again started. The same shoe has given the same trouble three or four times since then.

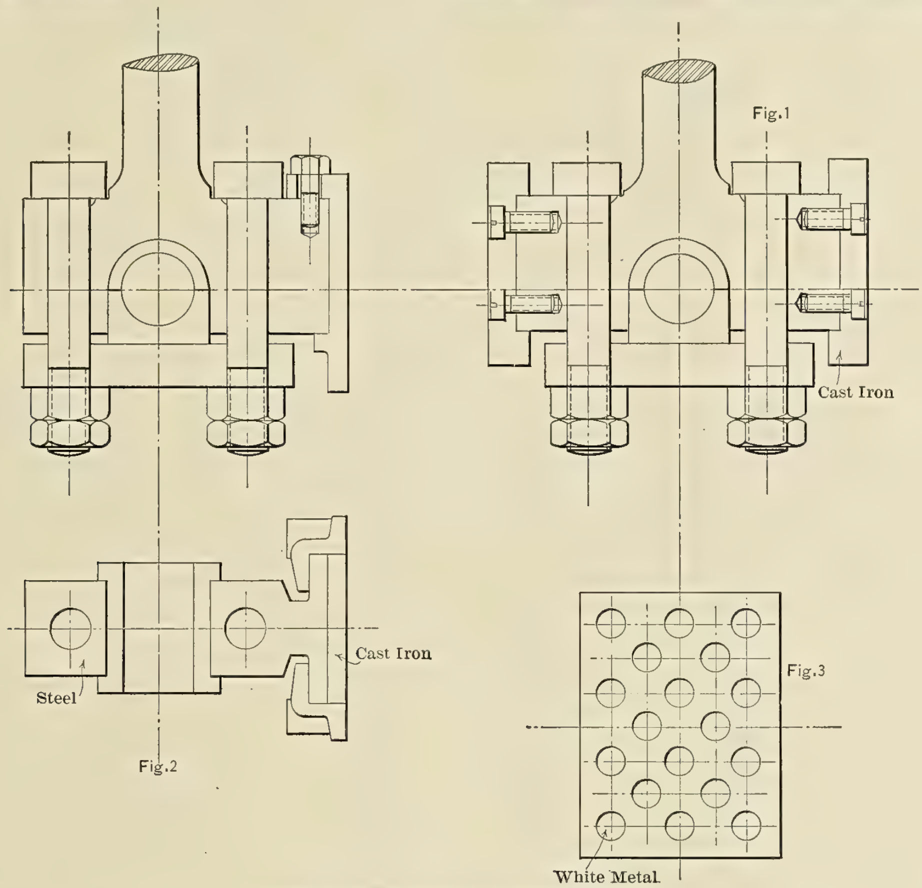
From the foregoing it is evident that this form of crosshead is not the best one, since once it becomes warm it will swell and the friction will then be greater, so that the temperature will again become higher and so on till the crosshead grips between the columns.

rods fell down on the floor plates, which were damaged, and the eccentric rods were also bent. The builder of this engine always after this lined the eccentric rings with white metal.

Cases are seldom found where cast-steel slippers are running on cast-iron guide plates, but the writer knows of several engines in which this construction is used, and it may be strongly recommended, as it has never given any trouble. For crossheads of the shape shown in Fig. 1, it is, of course, necessary to use white metal on the astern side. D. K.

Internal Feed Pipes.

The boiler of a small tug (an ordinary Scotch, with a single furnace) had been troublesome for a long time through priming badly—almost continuously with dirty or sea water.



VARIOUS TYPES OF MARINE CROSSHEAD SHOES.

After this experience the builders of these engines lined the shoes with white metal on both sides. This effectually did away with the heating of the crosshead, but the wear was greater, so the construction finally arrived at was to line the astern shoe only with white metal. This prevented the crosshead from gripping, but, at the same time, the wear was small.

Cast iron on cast iron in the form indicated in Fig. 2 gives no trouble, but many engine builders object to it and pour white metal in the shoes flush with the cast iron, as shown in Fig. 3. This is not at all necessary, but in settling the question of whether white metal should be used or not, the possible damage should be considered if the rubbing surfaces should grip, and it must be borne in mind that this cannot occur if one of them is lined with white metal.

The writer knows of at least one case in which the eccentric rings were not lined with white metal. On the trial trip of the vessel one of them gripped on the eccentric sheaves, causing the breaking of the drag rods and drag rod lever and the bending of the valve rod. The links with the

The main check valve was on the front of the boiler at about the level of the center line of the furnace and had no internal pipe, the boiler being too small for a man to get down between the tubes and shell to fit one.

The valve was taken from the front and fitted on the back of the boiler and an internal pipe fitted, with one row of holes having about 25 percent more area than that of the pipe. The pipe was fastened so that the *water was delivered towards the front or smoke-box end of the boiler.* We found the position of these holes a very important matter, as by giving the cross-pipe half a turn, to make it discharge towards the combustion chamber, the boiler primed again so much that the boat had to pull up, and we had to lower the steam and fix the pipe to discharge as at first. Ever since it has been found to be practically impossible to make her prime.

In another steamer, the check valve was on the side of the shell, about level with the third row of tubes from the top—no internal pipe was fitted. As there was always a certain amount of dirt among the tubes opposite the check, we de-

cided to fit a pipe similar to the first case; and on opening the boiler about ten weeks afterwards we were pleased to find it much cleaner than usual everywhere (the engineer said dirt had shifted that he had been trying to get rid of ever since joining the ship), all the loose dirt being heaped up on the bottom of the shell at the back end, as shown in Fig. 1.

In several steamers having to make up with river water, which is always more or less dirty, and makes a lot of hand-scaling necessary, their internal pipes were altered to the plan described above, and in every case the result was the same; the boilers in a few months becoming uniformly clean everywhere, and all the loose dirt being found heaped up at the back end of the bottom of the shell.

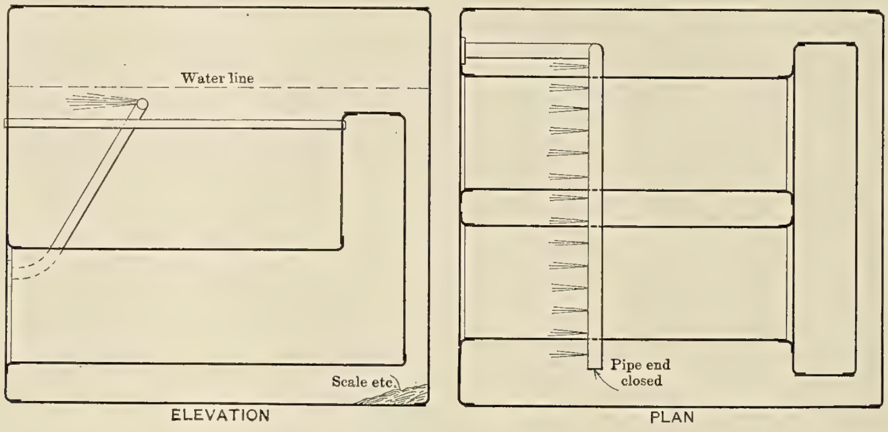


FIG. 1.

Of course an internal feed pipe is no novelty, most steamers now have them, but its arrangement is deserving of a little more study than is usually bestowed upon it. In the previous examples, each pipe as originally fitted was discharging, so that the circulation was checked instead of assisted, and when the boilers were emptied a lot of hard scaling was always done, but after fitting the pipe as shown in Fig. 1, hardly more than a brushing out was required. I think the best place for the cross-pipe is a little less than half the length of tubes from the front end.

For a double-ended boiler, something like the arrangement shown in Fig. 2 would be suitable; and it will be found that the result obtained will fully repay the expense of fitting. It is necessary to see that plenty of well-fitting hangers are used to support the pipes.

Drazit.

New Zealand.

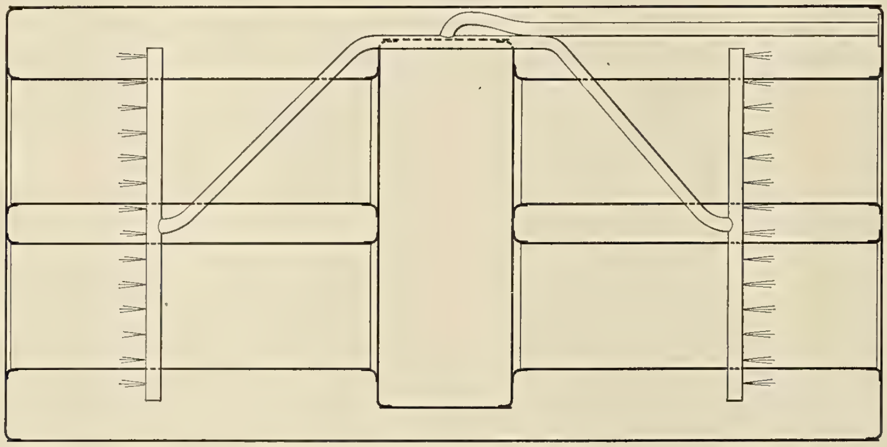


FIG. 2.

A Broken Injection Pipe.

It is not altogether an easy matter in making repairs in a marine-engine room, where space is very restricted, and very often time is precious, to exercise the right amount of care in order to secure that no damage is done during the operation. In one instance, the engineer on board a vessel had been overhauling the condenser, and was putting the door on, when the chain sling on which the door was hanging snapped, and the door came down suddenly, struck the copper injection pipe, and stuck there. As it was impossible to take the pipe out and send it ashore in order to have a patch put on, the position was a bit serious. There was a very nasty gash in the pipe, passing three-quarters of the way round its circumference and measuring about 1½ inches in width. As the pipe was 12 inches diameter, it was a job which required a certain amount of care in handling in order to effect a working repair. In order to allow the ship to proceed on her voyage the gash in the pipe was, first of all, lapped with canvas, so that the gap was completely covered all the way round, with a wide margin on either side. A box cradle was then made so as to go round under the pipe and passing well up the sides, a clearance of 3 inches all round the pipe being left. Into this space was run a mixture of Portland cement, with a bit of soda in it in order to stiffen it, and in a short time there was a solid 3 inches of cement round the gash. So well did this repair succeed that, although it was only regarded, at first, as a temporary expedient, it was allowed to remain in place, and, as a matter of fact, has been in continuous service for over three years since the unfortunate accident occurred.

A. H. S.

Repairs to a Broken Thrust Shaft.

While the Red D Line steamship *Zulia* was running from Maracaibo, Venezuela, to Curacao one of her thrust shafts broke just aft of the after ring in the backing thrust block. The mishap occurred at 3:20 A. M. on a Sunday morning while the second assistant was on watch. When the break occurred, it was supposed that the propeller had momentarily lifted out of water and caused the racing of the engine, but a few seconds showed that something worse had happened, and only quick action on the part of the second assistant saved the engine from damage.

The broken shaft was blocked up as soon as possible, and the vessel proceeded to Curacao with but one propeller working. Preparations were immediately made to repair the broken shaft in order to enable the vessel to complete her homeward voyage to New York, with the loss of the least possible amount of time.

There are four rings on the backing thrust and six rings on the go-ahead thrust. The break, as previously stated, occurred just aft the after ring in the backing thrust, and was due to an old crack in the shaft, which left only about 3 inches of metal in the center of the shaft to transmit the load. The shaft was broken off almost as squarely as if it had been severed with a hack saw.

The backing-thrust block was first removed and the last collar drilled off. Then two keyways, 8 inches long and 1¾ inches wide, were cut in opposite sides of the shaft. Cutting off the collar and cutting the keyways took all hands about four days working 24 hours a day. An old thrust ring from another ship was secured at Curacao, but this was 6½ inches inside dinameter, while the shaft of the *Zulia* was 7¾ inches diameter. This ring, therefore, was chipped out with a hammer and chisel to fit the shaft of the steamship *Zulia*, and two keyways were cut in the ring at the top and bottom to correspond with the keyways in the shaft. It was also necessary to cut the sole plate to clear the bolts on the ring. The oil box was cut off the steady bearing aft the break and a clip of ¾-inch iron was placed around the shaft and secured with four ⅞-inch follower bolts against the steady bearing to give security in case the repairs should give way.

Four holes for ¾-inch studs were drilled into the ring at the aft end of the shaft, and the studs driven into the shaft through the ring and into the shaft a distance of 1¼ inches. At the forward end of the break two holes were drilled for ¾-inch studs through the ring and shaft, and the second collar on the shaft was drilled through for a 1-inch stud in order to hold the ring in place.

It took from 8 P. M. Sunday until Friday evening to complete the repairs. The vessel sailed from Curacao to Laguayra, Venezuela, a distance of 196 miles, and arrived the following evening at 7 P. M. As the port was closed, she cruised around all night, and the following morning loaded her cargo and left Laguayra on Monday, arriving at New York on Thursday, March 10, a distance of 1,860 miles. During this time the engines were not stopped, nor was the repaired shaft touched. The engine was run at practically full power and the weak shaft was not favored. Of course, with the backing thrust block out of commission, this engine could only be run ahead. When it was necessary to reverse, the other engine had to be depended upon.

This is one of the cleverest repair jobs which has been executed recently, and reflects much credit upon the chief engineer, and his assistants, who carried out the work under such difficult circumstances. The engine-room staff which accomplished this work included Harry Stout, chief engineer; P. Burns, first assistant; W. Brown, second assistant; E. Johnson, third assistant.

The *Zulia* is a twin-screw steamer of 1,713 gross tons, built in 1901 by the Neafie & Levy Ship & Engine Building Company, Philadelphia, Pa. Her main engines consist of two sets of three-cylinder, triple-expansion, vertical inverted engines, with cylinders 14, 21 and 36 inches diameter and 26 inches stroke, aggregating 1,360 indicated horsepower. Steam is supplied at a working pressure of 160 pounds per square inch by two cylindrical-return tubular boilers, 12 feet 3 inches diameter and 12 feet 7 inches long. The boilers have a grate surface of 63 square feet, and a heating surface of 1,840 square feet.

A Broken Junk Ring.

The junk ring of a piston must be very stiff, so that the ring cannot bend when the junk-ring bolts are tightened up, as then the packing rings will have too much room and can move on the piston in an up-and-down direction. Junk rings are thus of ample strength for their work, and a case is seldom heard of where they have been broken.

On the tug *A* the drain pipes from the drain cocks in the bottom of the high-pressure cylinder and high-pressure valve chest were led to a feed tank and terminated there below the water level. These cocks should, of course, be shut after they have drained the cylinder and valve chest. This was forgotten after the stopping of the engine one night, the steam in the cylinder condensed, forming a vacuum, and then the water from the tank was pressed by the atmospheric pressure into the high-pressure cylinder. On starting the next morning the cylinder drain cock was opened too late, and the piston struck on the water. The piston body being smaller than the cylinder, a great force was exerted on the packing ring, and so on the junk ring, which broke radially through the bolt holes.

To make it possible to continue the journey, the high-pressure connecting rod was disconnected, and the piston and steam valve were removed. The valve stem was disconnected from the link block and the piston rod and valve stem fixed in the stuffng boxes, so as not to have any steam passed from the high-pressure cylinder, and then the cylinder and valve chest cover were put in place.

The engine was then started again, the live steam, reduced in pressure by a stop valve, being admitted to the intermediate-pressure cylinder. This starting was very difficult, as the cranks of this engine (compound) naturally were placed at 120 degrees. It ran, however, very regularly, and, as the captain took care not to stop the engine until the engine works were reached, no more difficulties were met. D. K.

Clyde-Built Brazilian Destroyers.

The torpedo boat destroyer *Alagoas*, one of ten destroyers ordered by the Brazilian Government from Yarrow & Co., and built by them at their Scotstoun yard, near Glasgow. The official full-speed trial took place in November on the Skelmorlie measured mile at the mouth of the Clyde during boisterous weather. The contract speed of 27 knots for three hours was easily obtained, carrying a load of 100 tons. The *Alagoas* is 240 feet long by 23 feet 6 inches beam. She is propelled by two sets of four-cylinder reciprocating engines of 8,000 horsepower, collectively, balanced on the Yarrow Schlick and Tweedy system. Steam is supplied by two double-ended Yarrow boilers of the latest type.

Six destroyers, built by Yarrow & Co., viz., the *Para, Piauhy, Amazonas* and *Matto Grosso, Rio Grande de Norte*, and the *Parahyba* have already gone out to Brazil. The firm have still three similar vessels under construction, viz., the *Santa Catharina, Parana* and *Sergipe*. These are nearing completion.

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Oil Fuel.

During the last few years the mechanical difficulties encountered in the use of oil for fuel on steamships have been practically overcome, so that its extensive adoption is now a question principally of the available supply and the relative cost of oil and coal. A comprehensive discussion of these two points is published elsewhere in this issue, and those who have not investigated these questions carefully will, undoubtedly, be surprised at the possibilities for obtaining a large supply of fuel oil at a reasonable price in the near future.

From statistics gathered by our correspondent, the total production of fuel oil in the world in 1904 was 219,000,000 barrels, of which the United States produced 53.4 percent, and Russia 35.82 percent. Comparing oil and coal on a basis of heat units the production of oil in the United States in 1906 was 7 percent as much as the production of coal. When it is considered that coal is largely used for industrial purposes for which oil, either on account of its inaccessibility or its properties as a fuel, could not be used, it is evident that the supply of oil in the United States is abundant for marine work. Furthermore, due to the fact that oil can be so easily transported by pipe lines and tank steamers, it can be delivered to any port in the country at a reasonable price, and since it is possible for a steamship to carry enough oil for a complete voyage to any part of the world and return, the practicability of its use as fuel in American naval and merchant vessels is evident. Not only is the present supply adequate, but the development of oil fields is practically in its infancy, and the possibilities for future development in this direction, both in the United States and in foreign countries, are great. It is probable that in the near future India will become a great producer. There are indications of large resources in various South American countries, in Turkey, Armenia, Africa and Persia, and in America future developments may be expected in Newfoundland and Labrador, Alaska, Mexico and Cuba. On the Pacific Coast of the United States coal is practically out of consideration as a fuel for industrial purposes, both ashore and afloat; oil has entirely supplanted coal ashore and has practically done so for marine work.

To compare coal and oil with reference to their economical use as fuel is difficult in many cases, since the calorific value of coal varies from 9,000 to 14,000 B. T. U.'s per pound, and since the availability and quality of both fuels in different parts of the world affect the price enormously. In general, however, it has been found that one pound of petroleum does the work of a pound and a quarter of coal and occupies 40 percent less bunker space. With oil fuel, the capacity of a boiler plant can be increased about one-third, or a given power may be obtained on about 25 percent less boiler capacity. One authority has stated that the difference in fuel consumption in favor of oil as compared with coal is about 33 percent, and that the saving in weight would permit an increase of about 50 percent in the steaming radius of a vessel. The principal advantages of oil as a fuel, aside from a saving in weight and space, are: Saving in labor (since the fire-room force can be cut to less than a quarter of that required for a coal-burning vessel); ease in handling and storing the fuel; speed in fueling a vessel; increased speed, due to the maintenance of steady fires and higher steam pressures; elimination of the cleaning of fires and the handling of ashes, and increased life of boilers (due to the constant temperature maintained). To offset these advantages there is the danger of explosion and accident, due to the use of oil; the loss of fresh water used in atomizing the fuel or the increased steam consumption if air is used for atomization; and the additional cost of auxiliary apparatus necessary to handle the oil, heat it and atomize it. The dangers attendant on its use can, of course,

be minimized by care in the construction and location of the oil tanks and in the selection of the oil. The minimum flash point for fuel oil for marine work is usually stated as 150 degrees, while the maximum moisture is 1 percent and the maximum sulphur ½ percent. The calorific value averages 18,000 B. T. U. per pound, and the specific gravity 15 and 17 degrees Beaume. The loss of fresh water, where steam is used to atomize the oil, varies from 1 to 4 percent of the total steam generated and necessitates a corresponding increase in the size of the evaporating plant.

It is only fair to say that the mechanical difficulties encountered in burning oil are well in hand. For marine work the method of burning oil is practically limited to atomization by steam or air, and since the former is wasteful of fresh water, it is probable that vessels on long voyages will be limited to air atomization.

The use of oil fuel for naval vessels is rapidly increasing, and, from a strategic point of view, the United States should take the lead in this respect. Already exhaustive experiments have been made by the Bureau of Steam Engineering, with the result that new oil fuel depots are to be established on both the Atlantic and Pacific Coasts, and in future provision will be made to insure an adequate supply of oil for naval purposes.

Development of Inland Waterways.

The development of inland waterways, such as the improvement of rivers, the digging of canals and the erection of warehouses, docks and freight-handling appliances at terminals, has been carried to a much greater extent in Belgium, Holland, Germany, France and Great Britain than it has in America. Many American writers are urging that far more attention be given to this subject by the federal government as well as by the different States. Nothing would be more gratifying to International Marine Engineering than to see a comprehensive plan started immediately for great improvements, especially in rivers in all parts of America. Undoubtedly in the near future the building of canals will not only be desirable but necessary.

Just at present, however, the prospect is not as bright as we wish it were, purely from the fact that the carriage of freight on American railways is much lower than in any of the other countries mentioned. One of the leading American experts on canal transportation recently compiled some figures as to the cost of transporting coal from Cumberland, Md., to New York City, by railroad, and also by water. The rates used in estimating the cost of transportation by railway were the actual charges as shown by the tariff sheet, whereas the estimated rates for canal tolls and other waterway charges were those now made on the canals of Belgium, which, we believe, are the lowest in any nation. The railroad charges per ton mile were almost exactly those of the water rates on the Belgium basis. Considering the fact that railroads are in operation twelve months in the year, whereas a considerable proportion of the waterways between Cumberland and New York are closed by ice four or five months in the year, the prospects for canal development are certainly not bright at present. There is, however, great demand for developing coastwise and local traffic, as well as the river traffic, in all parts of the United States, and the attention needed to carry out these improvements ought to be sufficient to keep our engineers busy for many years to come if the government will only undertake the work on a sufficiently comprehensive scale.

Internal Combustion Engines.

The internal-combustion engine for marine work has reached an interesting stage of development. In small sizes, suitable for use in motor boats, the internal-combustion engine using gasoline (petrol) as a fuel is supreme. Its weight is only about one-half that of a steam plant of the same power, and the weight of fuel used is about one-quarter of that necessary for the steam plant. Just as soon, however, as the size of the engine is increased to several hundred horsepower the cost of gasoline (petrol) becomes prohibitive for most purposes, and it is necessary to turn to some other fuel. The choice then lies between some form of petroleum or crude oil and producer gas generated from either coal or oil. Undoubtedly the field for heavy oil engines will, in the near future, be one of the largest in marine work. Certain types of oil engines require neither the electric nor open-flame ignition, and are, therefore, reduced to the simplest form possible for an internal-combustion engine, making them very valuable for use in fishing boats and for other commercial purposes where they must be operated by unskilled labor. Before producer gas comes into extensive use the first cost of such an installation must be very materially reduced in order that it may compete successfully with steam plants. Producer gas permits a direct gain in fuel economy over a steam plant. This fact has been established by the results obtained with hundreds of shore installations and also by the few experimental marine plants which have so far been made. Economy in fuel consumption, however, is only one consideration in the cost of a power plant, and any advantage derived from it can easily be lost if the first cost of the plant is excessive. Practically the only other fuels that give the internal-combustion engine an opportunity to compete in economy with steam are residuum and crude oil. The more refined grades of petroleum are too expensive. From the standpoint of economy, then, as compared with steam, the development of the internal-combustion engine is only just beginning, and the future possibilities in this field are great.

Progress of Naval Vessels.

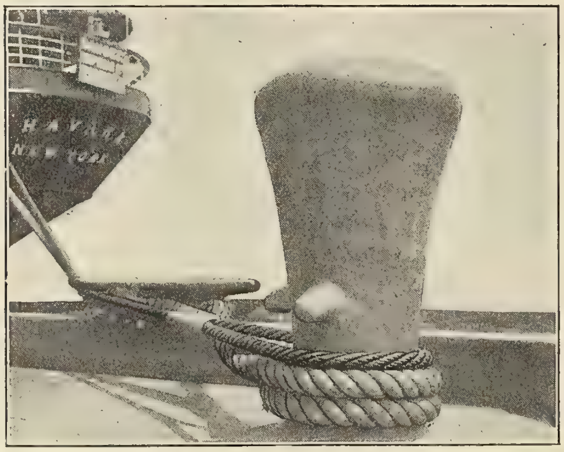
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Feb. 1.	Mar. 1.
BATTLESHIPS.					
Delaware ...	20,000	21	Newp't News Shipbuilding Co.	99.5	100.0
North Dakota	20,000	21	Fore River Shipbuilding Co..	98.6	99.1
Florida	20,000	20¾	Navy Yard, New York.......	50.5	55.2
Utah	20,000	20¾	New York Shipbuilding Co...	62.2	65.2
Arkansas ...	26,000	20½	New York Shipbuilding Co...	11.2	12.5
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	9.0	16.9
TORPEDO-BOAT DESTROYERS.					
Paulding ...	742	29½	Bath Iron Works............	64.6	71.8
Drayton	742	29½	Bath Iron Works............	59.9	67.4
Roe	742	29½	Newp't News Shipbuilding Co.	73.0	77.2
Terry	742	29½	Newp't News Shipbuilding Co.	72.1	76.6
Perkins	742	29½	Fore River Shipbuilding Co..	65.3	65.8
Sterrett	742	29½	Fore River Shipbuilding Co..	65.0	65.6
McCall	742	29½	New York Shipbuilding Co..	48.1	53.4
Burrows	742	29½	New York Shipbuilding Co..	48.1	53.4
Warrington..	742	29½	Wm. Cramp & Sons.........	60.3	62.7
Mayrant	742	29½	Wm. Cramp & Sons.........	60.9	64.9
Monaghan ..	...	..	Newp't News Shipbuilding Co.	10.1	14.8
Trippe	...	..	Bath Iron Works............	18.4	22.9
Walke	...	..	Fore River Shipbuilding No..	11.9	14.0
Ammen	...	..	Fore River Shipbuilding Co..	12.4	14.6
Patterson ...	...	..	Wm. Cramp & Sons.........	9.1	10.7
SUBMARINE TORPEDO BOATS.					
Salmon	...	..	Fore River Shipbuilding Co..	90.6	91.0
Seal	...	..	Newp't News Shipbuilding Co.	36.6	45.4
Carp	...	..	Union Iron Works..........	39.1	43.3
Barracuda ..	...	..	Union Iron Works..........	39.1	43.1
Pickerel	...	..	The Moran Co..............	36.9	40.25
Skate	...	..	The Moran Co..............	36.9	40.25
Skipjack	...	..	Fore River Shipbuilding Co..	16.8	31.3
Sturgeon ...	...	..	Fore River Shipbuilding Co..	16.6	30.9
Tuna	...	..	Newp't News Shipbuilding Co.	14.0	19.8
Tuna	...	..	Wm. Cramp & Sons.........	0.0	3.1

ENGINEERING SPECIALTIES.

Durable Wire Rope.

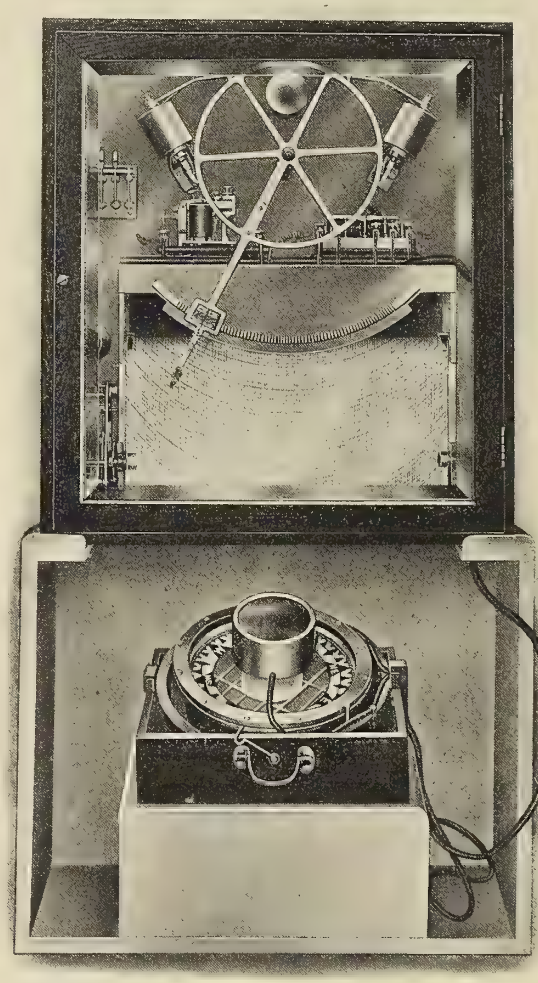
The accompanying illustration gives an excellent idea of the adaptability of Durable wire rope for all sorts of uses in the marine field. This rope is made of selected steel, and each strand is separately served with a specially prepared hemp marline. It combines the pliability and wearing surface of hemp or manilla rope, and is believed to have the strength



of wire rope. Because of the peculiar construction the strength of the wire is preserved far beyond the life of the ordinary wire rope, and the hemp serving binds the wire of the strands together, preventing wear between individual wires and forming a cushion between the strands. As will be seen in the illustration, this rope hugs the bit as closely and as satisfactorily as does the hemp rope also shown. The claim is made that Durable wire rope with a diameter of 1½ inches has an approximate breaking strain of 67,000 pounds, making it equal to a manilla rope over 3 inches in diameter, as regards breaking strain, but the claim is made that it will outlast two or three times the manilla rope. This rope is manufactured by the Durable Wire Rope Company, 90 Pearl street, Boston, Mass.

Schuette Recording Compass.

The Schuette recording compass, which is manufactured by the Schuette Recording Compass Company, Manitowoc, Wis., is so constructed as to produce a continuous record of the direction of a ship with relation to time; so that the direction in which the ship was moving at any hour and minute can be determined at a glance at any time thereafter from an inspection of the records produced. It is claimed that the



instrument shows variations of about two and a half degrees (or a trifle less than a quarter of a point), so that if a ship is on her course and the wheelman lets her go off about two and one-half degrees, the instrument will immediately register the change of direction and also the exact time this occurred, so that a captain, by looking over his chart, can tell whether his ship has been working to starboard or to port, and whether his instructions have been followed. The chart will also show the conditions of the weather, as in a seaway the records will be very irregular, while in smooth water a comparatively straight line will be produced.

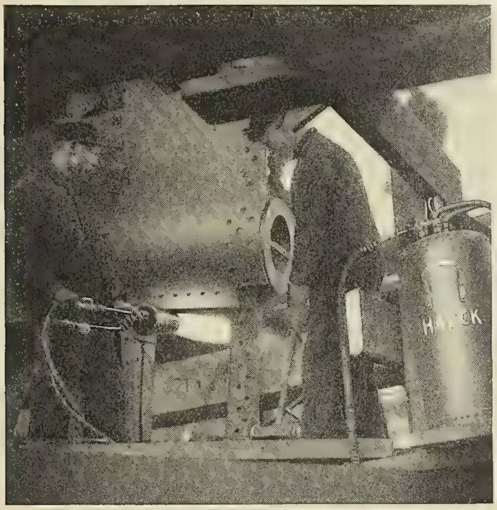
The size of the instrument is 2 feet square by 10 inches deep and it can be connected to any ordinary socket, anywhere on the ship, and any current can be used from 90 to 120 volts; it requires no attention except placing a new chart on the roll every month, and filling the pen about every two weeks. The clock movement which moves the chart exactly 2½ inches an hour is wound electrically and, it is claimed, requires no attention whatever. One of the special features is the cir-

cuit changer, which automatically throws the instrument on a set of batteries if the dynamo current for any reason should give out, and again throws the instrument on the dynamo circuit when the dynamo is again in operation, so that the apparatus in constantly in commission.

The chart will last 31 days and the time and date are printed thereon. The time is graduated to five-minute spaces, so that it is an easy matter to ascertain the time to less than a minute at a glance. All points east of north and south are shaded, while all points west of north and south are clear, so the chart can be read with comparative ease.

Hauck Patent Oil Fuel Burners.

The illustration shows an application of the Hauck portable oil fuel burner, which is useful in shipbuilding work. These burners are manufactured by the Hauck Manufacturing Company, Brooklyn, N. Y., and have been successfully used in various shipyards for heating distorted hull plates, frames and girders; for annealing armor plates; for flanging,



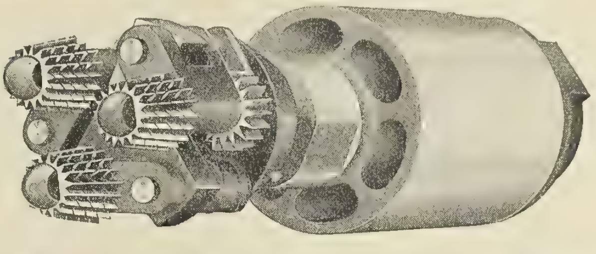
scarfing and shrinking, and for taking off propeller wheels and similar work. It is claimed that their use results in an enormous saving in time and labor. The outfit shown in the illustration is operated by compressed air and the apparatus can be operated under any pressure varying from 5 to 100 pounds per square inch. Any grade of fuel, crude or kerosene (paraffin) oil may be used.

New Form of Head for Boiler Tube Cleaners.

The Lagonda Manufacturing Company, of Springfield, Ohio, has recently brought out a new boiler tube cleaner equipped with what is known as the "quick repair head." This head is attached to the turbine proper by means of the coupling and an adapter. As can be seen from the illustration, which shows a "quick repair head" attached to a Weinland water turbine, a spider screws directly into the coupling, and has three arms on the end of which are attached the swinging arms carrying the cutter wheels. There are four cutters on each swinging arm; the front one being of the cone pattern, is the first to attack the scale and loosen it. Each cone cutter is then followed by three star cutters, which remove the scale down to the metal, leaving a bright, polished surface.

The most important feature of this head is the ease with which new cutters can be inserted. The cutter pin can quickly be removed by means of a wrench and all of the cutter wheels taken out. In case the entire head must be taken apart it is only necessary to unscrew the spider from the coupling; this allows the three arm pins to drop out and the whole head is dismantled. There are no rivets or small parts used, and as the makers furnish an extra supply of sharp cutter wheels with each head there is no reason why any operating engineer should struggle along with a scale remover having dull cutter wheels.

The quick repair head is compact and heavily built. The arms are thrown out against the scale by the action of centrifugal force. This causes the cutter wheels to bear firmly

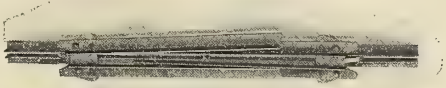


against the scale, but should a constricted part of the tube be met the arms fold in and, it is claimed, do not injure the boiler tube. The flywheel effect of a compact head like this is quite noticeable. When exceptionally hard scale is encountered it is only necessary to back the cleaner out a little and let the head speed up, and when it is again forced against the scale it is generally found that the cleaner will eat its way through without any further trouble.

A Collapsible Steel Horse or Trestle.

A collapsible steel horse or trestle has recently been patented and is now being manufactured by S. M. Hildreth & Company, 2 Rector street, New York City. As can be seen from the illustration, it is a strong, simple, convenient and practical appliance for innumerable uses, such as are builders, carpenters, contractors, machine shops, painters, piano movers, pipe works, manufacturing plants, stores and shops of all kinds, and for various other purposes too numerous to

STEEL COLLAPSIBLE HORSE.



HORSE FOLDED UP.

mention. The horse is made of nickel iron and is, therefore, very rigid and strong, precluding any chance of breakage. It is made in several heights and lengths, suitable for various purposes. The legs fold up when the trestle is not in use, so it can be stored away in a very small space and conveniently handled in transporting. It is claimed that they will withstand more weight than any other horse or trestle of the same size.

Hydro-Tele-Motor Steering Gear.

A new steering gear has been placed on the market by Hanchett & Dannheiser, 237 Fulton street, New York, in which the

power impressed upon the wheel by the hand is transmitted hydraulically to the rudder through small and flexible copper pipes, the advantages claimed being the greater reliability of performance, the elimination of loss of motion and power, and the indifference to atmospheric changes or other weather conditions, while the greater facility with which it can be used in connection with mechanisms for the multiplication of power increases the range of hand-power steering.

The hydraulic principle is shown diagrammatically in Fig. 1, in which are displayed two stationary pistons, which are traversed by a double cylinder. The water, upon operation of the lever handle, comes and goes in the two sides of this cylinder through ducts, which pass along the center of the pistons and discharge into pipes leading to an exactly similar device actuating the rudder. The system being filled with water, it is obvious that when cylinder *A* is moved by means of the lever arm, cylinder *B* must move in the opposite direction a corresponding amount, causing an equal movement of the rudder; also a reverse movement of the lever throws the rudder to the other side. In every case the movements of the

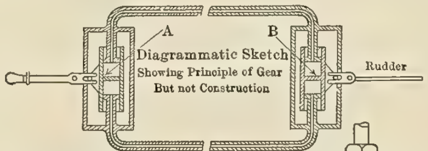


Fig. 1

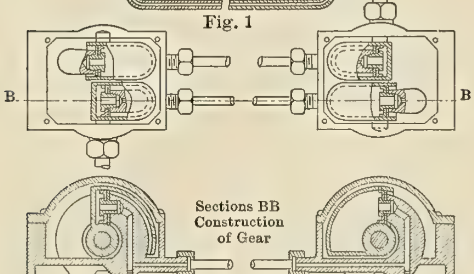


Fig. 2

one cylinder are exactly duplicated by the other. To keep the system supplied with water and to prevent the entrance of air, the cases enclosing the cylinders are filled with water, completely submerging them. Also should water be lost by leakage past the pistons upon a compression stroke, the suction of the next return stroke will restore it, for the cup leather fittings at the piston ends are so contrived that they are slow to allow the escape of water and rapid to permit its ingress. Thus the natural motions of the wheel in steering keep the wheel and rudder in correct relation to each other. In other words the device is self-equalizing.

The device as actually constructed retains the hydraulic principle shown in Fig. 1, but its form is varied to secure mechanical advantages. Thus the cylinders instead of being straight are curved, which permits of their being mounted on a shaft, whereby the oscillations are given a rotary direction. This and other details are shown in plan and section in Fig. 2.

In an installation the two motors are mounted at the steering station and upon the rudder stock, respectively, and are connected by two copper pipes about ¼ inch in diameter. These pipes can be run like wire through partitions, under floors and about obstructions, without joints and without detriment to their serviceability. The fluid used in actual practice is a mixture of alcohol, glycerine and water, that it may be non-freezing. It is said that a helm so equipped has a lightness of touch and a promptness of response hitherto unknown in the steering of boats.

On her final trials, with 27,212 horsepower and 280 pounds per square inch steam pressure, the Brazilian battleship, *Minas Geraes*, made a speed of 21.431 knots, with 147.47 revolutions.

COMMUNICATION.

The Largest Wooden Ships.

Editor International Marine Engineering:

In the issue of your magazine for January, 1910, I notice an article giving a description of the schooner *Wyoming*, which was launched at Bath, Maine, December 15, 1909. In the article it is stated that the *Wyoming* is the largest wooden sailing vessel ever floated, and also that the master builder, Miles M. Merry, holds th etonnage record for square riggers, as well as for fore-and-aft vessels, as it was he that built the ship *Roanoke* for the Sewells some eighteen years ago, which was the largest ship ever built of wood.

I think both of the foregoing statements should be corrected, since nearly fifty-seven years ago on the 4th day of September, 1853, there was launched from the shipyard of Donald MacKay, at East Boston, Mass., a full clipper ship christened the *Great Republic*. She was 334 feet 6 inches long over all, with a beam of 53 feet 6 inches and a depth of 38 feet. Her gross tonnage was 4,555 and she was built of wood. The *Great Republic*, therefore, exceeds the *Wyoming* in size by 825 tons, while she exceeds the *Roanoke* by 1,016 tons. The only dimension in which the *Wyoming* exceeds the *Great Republic* is in the overall length and this is caused by her great overhang, the difference between the overall length and the length of keel being 46 feet, while the corresponding difference in the *Great Republic* was only 16 feet 5 inches, making the length of keel of the *Great Republic* 14 feet 1 inch longer than that of the *Wyoming*. The *Great Republic* was a four-masted vessel square-rigged on three masts.

Capt. E. M. Greenleaf.

Seattle, Wash.

TECHNICAL PUBLICATIONS.

Motor Boats; Construction and Operation. By Thomas H. Russell, M. E., LL. B. Size, 5½ by 7½ inches. Pages, 288; numerous illustrations. Chicago, 1910: The Charles C. Thompson Company. Price, flexible leather binding, $1.50; cloth binding, $1.00.

This book is intended as a guide to the motor boat enthusiast who is not a practical mechanic. It describes a modern motor boat, gives hints on amateur boat building, and takes up in detail marine gasoline engines of all types, including all their auxiliaries. Undoubtedly a large percentage of motor boat owners have little knowledge of mechanics in general, or of gas engines in particular, before they undertake either the building or operation of a motor boat, and such people will find the book of great value. Considerable space is devoted to troubles that are likely to arise in running marine engines and the best way to avoid them.

The Design and Construction of Internal Combustion Engines. By Hudo Güldner. Translated by Prof. H. Diederichs. Size, 8½ by 11 inches. Pages, 672. Illustrations, 728. Folding plates, 36. New York, 1910: D. Van Nostrand Company. Price, $10 net.

Probably nowhere has the gas-engine industry been developed to such an extent as in Germany, and German technical literature on this subject shows the same high degree of development, but prolific as writers have been regarding the gas engine, most of them deal principally with the existing types of engines and the thermodynamic problems involved, and do not take up thoroughly the problems involved in actual design and practical construction. For the practical designer such books are of little help, since he is thoroughly conversant with most of the subject matter himself. Most of the information regarding practical problems of design and construc-

tion of gas engines has been obtained through expensive experimentation and development by individual manufacturers, and, consequently, it has in most cases been jealously guarded and kept for the exclusive use of the manufacturer himself. The author of this book has endeavored to place before the reader a complete practical treatise on the mechanical and kinetic side of gas-engine design and construction, and in this respect the work is unique. The author's personal experience has extended over a great many years of active work as a gas engine designer and builder, and this has enabled him to present a book which is of far greater value than any other publication which has come to our notice in the gas engine field. The book is divided into four parts with an appendix. Part I. takes up the various methods of operating gas engines and the gas-engine cycles. Part II. takes up the design and construction, including the determination of the principal dimensions, general engine parts, special parts for gas and oil engine and auxiliaries. Part III. takes up the construction, erection and tests of internal-combustion engines, and under this head nearly every type of German and American gas engine is illustrated and described. Part IV. deals with gas engine fuels and combustion, while the entire thermodynamic discussion is taken up in the appendix. The book is profusely illustrated, and the translator has added considerable valuable material regarding American gas engine practice.

Olympia Exhibition.

A naval, mercantile marine and general engineering and machinery exhibition will be held at Olympia, London, W., Sept. 1 to 26, 1910. Three years have elapsed since the last engineering exhibition was held at Olympia, and immense strides have been made in marine and mechanical engineering. Since mechanical engineering in all its phases enters into every branch of naval and mercantile marine engineering, it is expected that the forthcoming exhibition will greatly surpass the previous displays of machine tools and general engineering exhibits, and that particularly the prominence given to marine engineering will serve the dual purpose of bringing before shipbuilders and all who are responsible for the administration of naval and mercantile marine affairs the latest and most up-to-date appliances in connection with naval architecture and marine engineering, and also of educating the general public regarding the multitudinous details connected with naval and maritime matters generally

Omission.

In the description of the steamship *Herman Frasch,* which we published on page 66 of our February issue, we omitted to state that the specifications for this vessel were drawn up and the construction work supervised by Jacobs & Davies, Inc., consulting engineers, 30 Church street, New York.

PERSONAL.

FAYETTE BOWN, president of the Brown Hoisting Machinery Company, Cleveland, Ohio, died Jan. 20, 1910, at the age of eighty-seven.

L. D. MOSLEY, formerly chief engineer of the steamship *Yale* of the Metropolitan Line, has recently been transferred to the steamship *Harvard* of the same line. Mr. Mosley has made a splendid record on the *Yale,* and the transfer was due to the fact that the *Harvard* needed tuning up, and Mr. Mosley was considered to be the best man to put her in shape. E. G. Bernard, formerly chief assistant engineer of the *Yale,* has been made chief engineer of that vessel. We are very glad to see that merit counts.

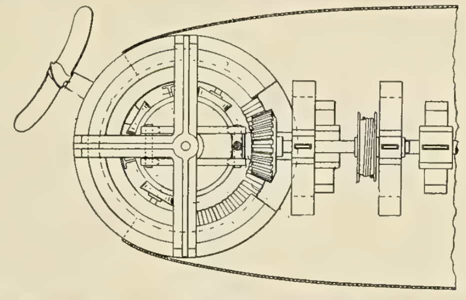
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

940,039. PROPELLING AND STEERING DEVICE FOR VESSELS. WALTER B. MARBLE, OF TACOMA, WASH.

Claim 1.—In a propelling and steering mechanism, the combination with a fixed rotating engine shaft; an angularly adjustable propeller shaft; a set of beveled friction cones and rings adapted to drive the propeller shaft from the engine shaft irrespective of the angular relation therebetween; and means for controlling the angular position of the propeller shaft. Four claims.



937,572. BOILER. HARRY R. BAILEY AND JACOB E. McFARREN, OF MASSILLON, OHIO.

Claim 2.—In a boiler, the combination of an upper drum provided with circulation flues, supporting walls therefor with intervening gas circulation space, lower independent rectangular water headers at front and back having flanges flush with the outer walls, removable cover plates secured to said flanges, water tubes screwed into the inner walls of and connecting said headers, water circulation legs connecting the headers with the lower portion of the upper drum at front and back, and means for producing combustion below the front header and circulation of the gases upwardly around the headers, tubes, water legs and through the circulation flues of the drum. Two claims.

941,776. ANCHOR. MILAN W. HALL, OF BROOKLYN, N. Y.

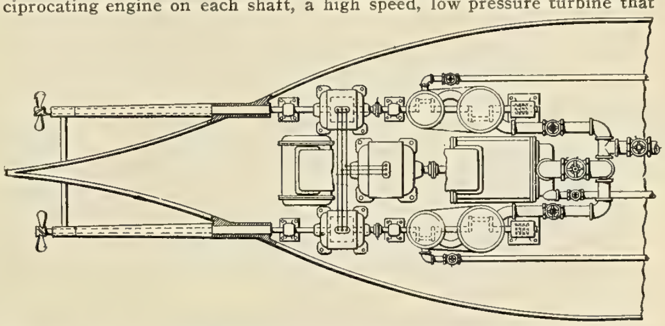
Claim 3.—An anchor comprising a shank, a mushroom head and a plurality of independent pivoted flukes, the palms of the said flukes being arranged, when in their operative positions, to lie in the line, and to form a substantial continuation, of the mushroom head. Fifteen claims.

943,604. SUBMARINE BOAT. RAYMOND D'EQUEVILLEY-MONTJUSTIN, OF KIEL, GERMANY.

Claim 1.—A submarine boat having a conduit in communication with the outer water and through which water is made to circulate to develop the diving action, the lower portion of said conduit leading in a substantially vertical direction from the bottom of the boat, and means causing a flow of water through said conduit, acting upon the water within said conduit in a direction substantially transverse to the diving direction whereby the reaction of said means is not exerted in a direction to influence the living action. Eight claims.

945,925. SYSTEM OF POWER DISTRIBUTION. WILLIAM L. R. EMMET, OF SCHENECTADY, N. Y., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—In a power system for propelling ships, the combination of twin shafts, a propeller on each shaft, a low speed, high pressure reciprocating engine on each shaft, a high speed, low pressure turbine that is driven by the engine exhaust, an electric generator driven by the turbine, electric motors constructed and organized to operate at the same speed which are mounted one on each of the said shafts and co-operating with the engines to drive the shafts, and conductors conveying current from the generator to the motors in multiple. Fifteen claims.



942,855. ANTI-DRIFTING DEVICE. ELIAS GUNNELL, OF MANITOWOC, WIS., ASSIGNOR TO MANITOWOC DRY DOCK COMPANY, OF MANITOWOC, WIS., A CORPORATION OF WISCONSIN.

Claim 1.—The combination with a scow having an open bottomed dumping well extending throughout its length, of an anti-drifting flap hinged on a vertical axis and lying in the well, and means whereby the flap may be held in a position transverse to the well. Six claims.

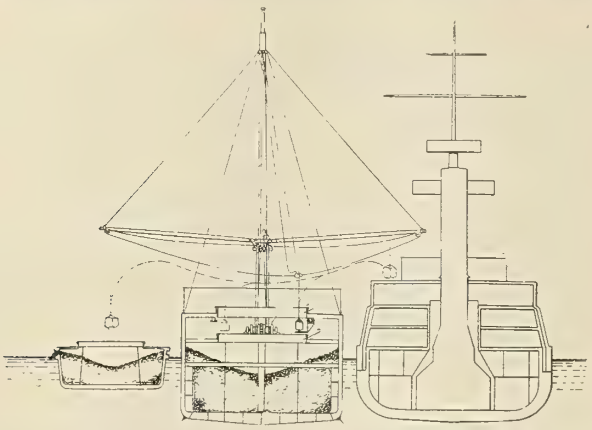
943,833. AIR HEATER FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 2.—In an automobile torpedo the combination with the reservoir of air under high pressure, the engine, the conduit leading from the

reservoir to the engine, the reducing valve in said conduit, the heater in communication with said conduit on the low pressure side of said valve, and the fuel tank, of a valve controlled by the relative pressures in the heater and fuel tank, and controlling the flow of high pressure air to said tank. Four claims.

943,694. COLLIER AND COAL-HANDLING APPARATUS. THOMAS SPENCER MILLER, OF SOUTH ORANGE, N. J.

Claim 18.—In a boat, in combination, two rope-drum engines located on opposite sides of a hatchway, a hoisting rope extending from a drum of the first engine over an elevated sheave from which its fall is pendent



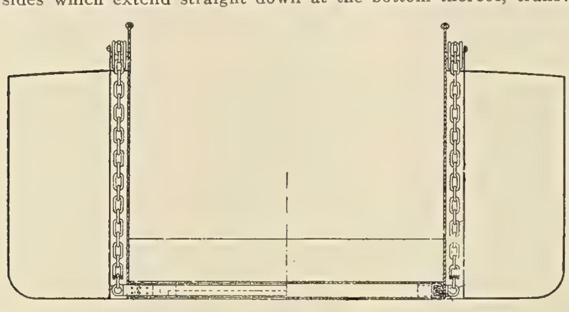
through said hatchway, a swinger guide engaging said fall, a rope connecting said swinger guide with a drum of the first engine and a rope connecting said guide with a drum of the second engine. Fifty-six claims.

945,123. PROPELLER. FYNIS C. GORDON, OF CLEVELAND, OHIO, ASSIGNOR TO GORDON PROPELLER COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

Claim 1.—In a reversing propeller, the combination with a main shaft, a spherical head secured thereto and provided with recesses, a gear disposed in one of said recesses and the ends of propeller blades disposed in other of said recesses, said ends being provided with teeth arranged to mesh with teeth on said gear, and a two-part casing provided with openings to permit a portion of said gear and said blade ends to project therethrough, said casing having threaded extensions arranged to receive retaining nuts. Three claims.

946,059. HOPPER DREDGER AND BARGE. FRED LOBNITZ, OF CROOKSTON, SCOTLAND.

Claim 1.—A hopper barge or dredger having, in combination, a hopper with sides which extend straight down at the bottom thereof, transverse

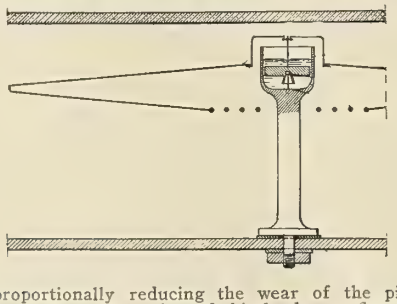


hopper doors adapted to close tightly against said straight sides, lugs on the sides of the hopper doors at the closing edges thereof and adapted to pass through the side of the hopper, and means external of the hopper for operating said doors. Two claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

18,615. MARINERS' COMPASS. L. D. J. A. DUNOYER, VERSAILLES, FRANCE.

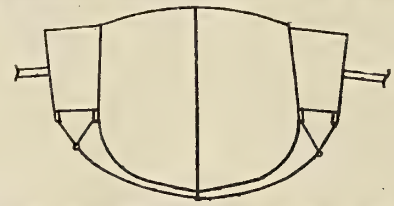
This invention consists in retaining dry cards with a weak magnetic moment; remedying their lack of sensitiveness due to the friction of the pivot by considerably diminishing the load carried by this pivot, and



consequently proportionally reducing the wear of the pivot. This is done by carrying the larger portion of this load on a float plunged in a bath of liquid, such as mercury arranged at the center of the card, so that the load carried by the pivot may be only a small fraction of the total load.

21,348. RAISING SUNKEN VESSELS. R. J. TRELEAVEN, LEYTON.

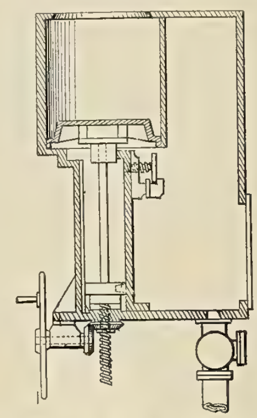
Flat sided receptacles, open at their lower ends, are attached around the exterior of the vessel to be raised, which contain inflatable balloons, or the like. Such balloons are inserted in receptacles, prefarably of metal, and of triangular section, enlarged at their upper end so that



when the balloons are inflated they will rise with this end uppermost, their flat faces against the sides of the vessel. The balloons may be secured within cases and a connector be fixed in the body. The panels of the cases might be made of chain or rope netting.

5,832. SUBMARINE BOATS. J. FRASER, GLASGOW.

Relates to a means of escape from submarines. The apparatus is first closed by raising a door to shut the port, then the screw is turned to engage the hole, and so keep the door closed. The water is then



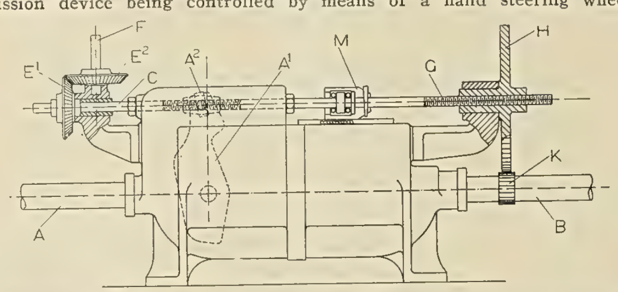
cleared out by means of an air pipe. A person wishing to escape enters by the door, which he closes tightly and retracts the screw to allow the door to drop so that he may escape by the opening. The above cycle of operations is repeated for the next person leaving.

21,899. PROPULSION OF VESSELS BY HIGH-SPEED ENGINES AND MOTORS. G. L. M. DORWALD, LONDON.

This invention provides for running the engine at its maximum and most economical speed, and a propeller of a large diameter at a reduced speed, with a propelling effect in proportion to the power of the engine. Thus the advantages of maximum speed of engine and better relation between area of propeller and cross-sectional area of the vessel are combined. Where twin screws are used, the engine shaft has a double clutch, either portion of which can be brought into action. Attached to each part is a sprocket wheel, and on each of the propeller shafts is a sprocket wheel, both wheels operable by chains, the diameters of the sprocket wheels giving the required speed to the shafts. The propellers are of opposite pitches, one right handed and the other left, and their shafts are geared together so that they rotate in opposite directions. The direction of rotation of the shafts therefore depends on which portion of the clutch is in action.

26,060. SHIP'S STEERING APPARATUS. A. F. PETCH, WESTMINSTER.

The invention consists in a combination of a constant-speed motor or engine with variable rotary-speed hydraulic transmission device consisting of a variable delivery hydraulic pump and hydraulic motor, the transmission device being controlled by means of a hand steering wheel



and hunting gear. E^1, E^2 are the hand steering gears operating shaft *C*, which is screwed to engage a nut A^2 for inclining a member A^1, on the angle of which the rotation of shaft *B* depends. This shaft operates the steering gear and carries a pinion engaging a wheel *H*, whose hub is the nut of a screwed part of the shaft *G*, which does not rotate, but is coupled at *M* to the shaft *C*.

26,570. MEANS FOR LOCATING SUNKEN VESSELS. N. KRAVTCHENKO, ST. PETERSBURG, RUSSIA.

The invention relates to a buoy furnished with a lamp and a telephone. This buoy is carried by the submarine and is attached by a cable to a drum, the axis of which is used as a passage for conducting wires. When the submarine sinks, the buoy is freed by one of the imprisoned crew, and, uncoiling the cable from its drum, rises to the surface, automatically lighting the lamp. Rescuers, seeing the light, locate the ship at once, and may communicate with the crew after unscrewing the cap on which the telephone is hooked.

International Marine Engineering

MAY, 1910.

15-YARD DIPPER DREDGE.

The dipper dredge has several advantages over all other types of dredges for certain work, and on this account it has been highly developed in North America. In the first place, no mooring lines are required, so that where the dredge is reclaiming swamp land it is not necessary to have men out on the bank, and where digging a ship channel it is possible for the dredge to operate continuously, offering the least obstruction to navigation. The reason for this is that the dredge to be excavated. It is thus possible to bring up large masses of rock, sunken timber, etc., which could not be done with any other dredge. It enables the operator to feel around on the bottom and attack large boulders in such a way as to bring them up successfully. In work of this nature the dipper dredge easily outdistances an elevator or clam-shell dredge, where in easier digging the advantage is not so marked. The dipper dredge is the logical complement of the drill boat.

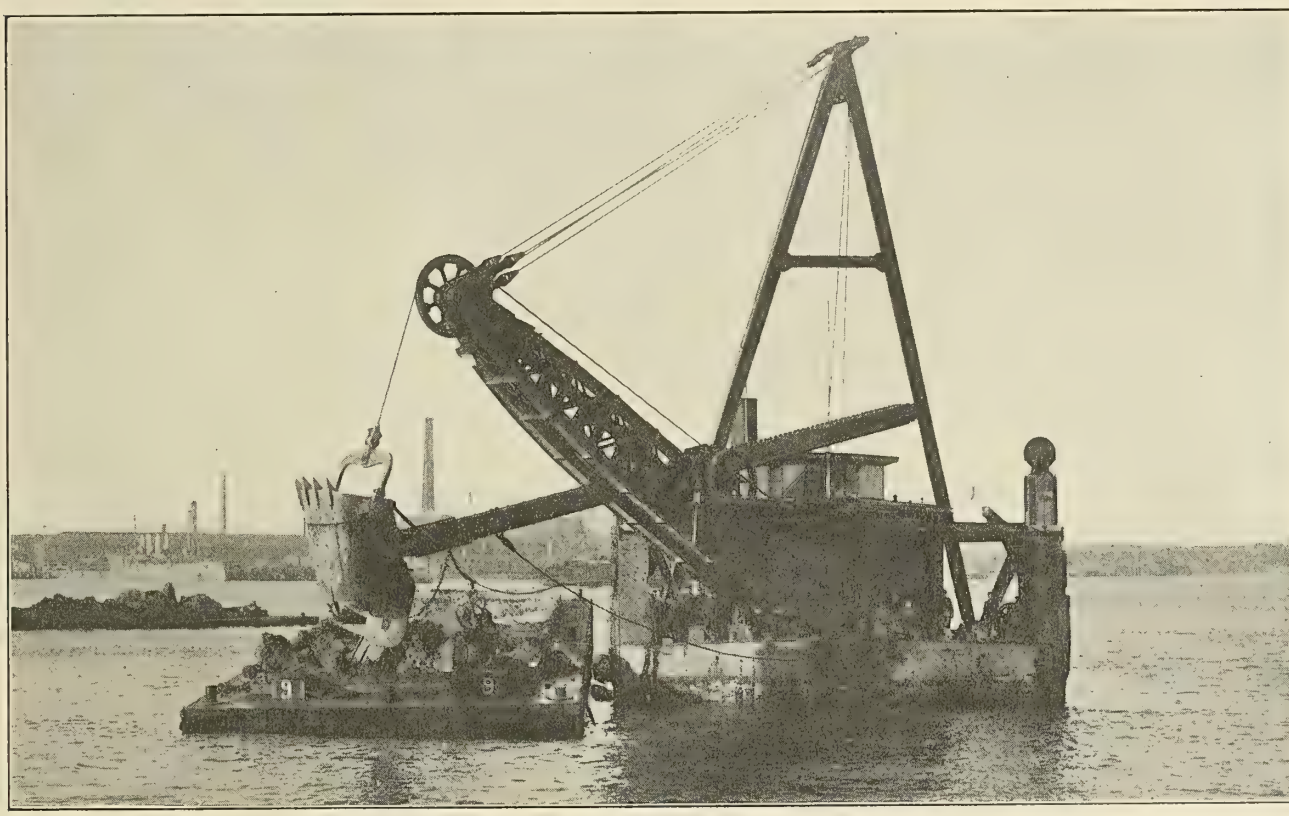


FIG. 1.—THE TOLEDO, SAID TO BE THE LARGEST DIPPER DREDGE IN EXISTENCE.

operates on what are known as "spuds." These are heavy posts, which, if the dredge is large, are usually built up of several timbers, and so arranged with respect to the hull that they may be forced down to the point of refusal in the material in the bottom of the channel, thus forcing upward the bow end of the dredge and making of it a stable platform, enabling the dipper to be forced into the material to be excavated with much greater effect than where a dredge is held to its work by mooring lines only.

The second advantage of the dipper dredge is that it is possible for the operator to exercise the greatest control at the contact of the digging part of the machine with the material

The third advantage is the fact that it requires a very much smaller first cost to obtain a dredge which is able to apply effective digging force to the material to be excavated.

The largest dipper dredge in existence is the dredge *Toledo*, built for work in Broad Sound in connection with the improvement of Boston harbor. It is at present digging fairly good material, but will soon return to the work in Broad Sound, which is quite hard and must be dug in a seaway. The dredge is capable of digging to a depth of 55 feet below the water surface.

There are other dredges which handle a 15-yard dipper, but they are what are known as "combination dredges," which can

be rigged up to use either a clam shell or a dipper. In either case the swinging is done in the manner used on all clam-shell dredges, which results in a very slow swinging movement and very little control over it. These dredges also do not use spuds, and therefore are unable to exert so much power in the excavation of the material. The machinery and power plant on these other dredges, therefore, do not correspond in any way with the similar parts on the *Toledo*. The length of the hull is 135 feet, breadth 44 feet, average depth 13 feet 6 inches. All of the engines are in the hold with the exception of two small engines on deck for operating the winches for warping scows.

The hoisting engines are horizontal, twin-tandem, compound condensing, with Stevenson link valve motion. The valves on the high-pressure cylinders are piston valves, and those on the low are flat slide valves. These engines are compound geared to a large spur gear on either end of the hoisting shaft which carries the hoisting drum. This drum is grooved for 3-inch wire rope and is conical, giving the maximum digging power and slowest speed when the dipper is down and the angle between the dipper handle and the hoisting rope is small, and gradually increasing in speed and decreasing in power as the angle between the dipper handle and the hoisting rope becomes greater, allowing a more effective pull on this account. The drum is mounted loose on the shaft, and is driven by means of a very successful clutch arrangement, which has proved to be the only device which will take care of the enormous power of the engines. The clutch is operated by a steam cylinder.

The backing engines are horizontal, double-cylinder, single-expansion engines, geared directly to the gear on the backing shaft, which operates a cylindrical backing drum, grooved for wire rope and made to revolve with the gear by means of a clutch operated by a steam-thrust cylinder.

The swinging machinery consists of a horizontal, double-cylinder, single-expansion engine, compound geared to a large gear on the swinging shaft, which is fastened directly to the cylindrical swinging drum, to which drum the two swinging ropes are led in such a way that, by reversing the engine, the boom may be swung from side to side.

Each forward spud is raised or thrust downward by a horizontal, double-cylinder, single-expansion engine, compound geared to a large gear mounted on the spud drum shaft. The drum is cylindrical, grooved for wire rope, and is connected directly to the gear with a very effective brake apparatus, operated by a brake cylinder, which can produce and maintain a carefully graduated restraint on the motion of the backing drum, or hold it in one position. It has been found that the digging pull is so tremendous on this dredge that it is necessary to use spud pads on the bottom of the forward spuds. These pads are attached to the spud by a pin through the spud, allowing some motion to the pad independent of the spud. These pads are 6 to 8 feet across, and prevent the spud from sinking too far.

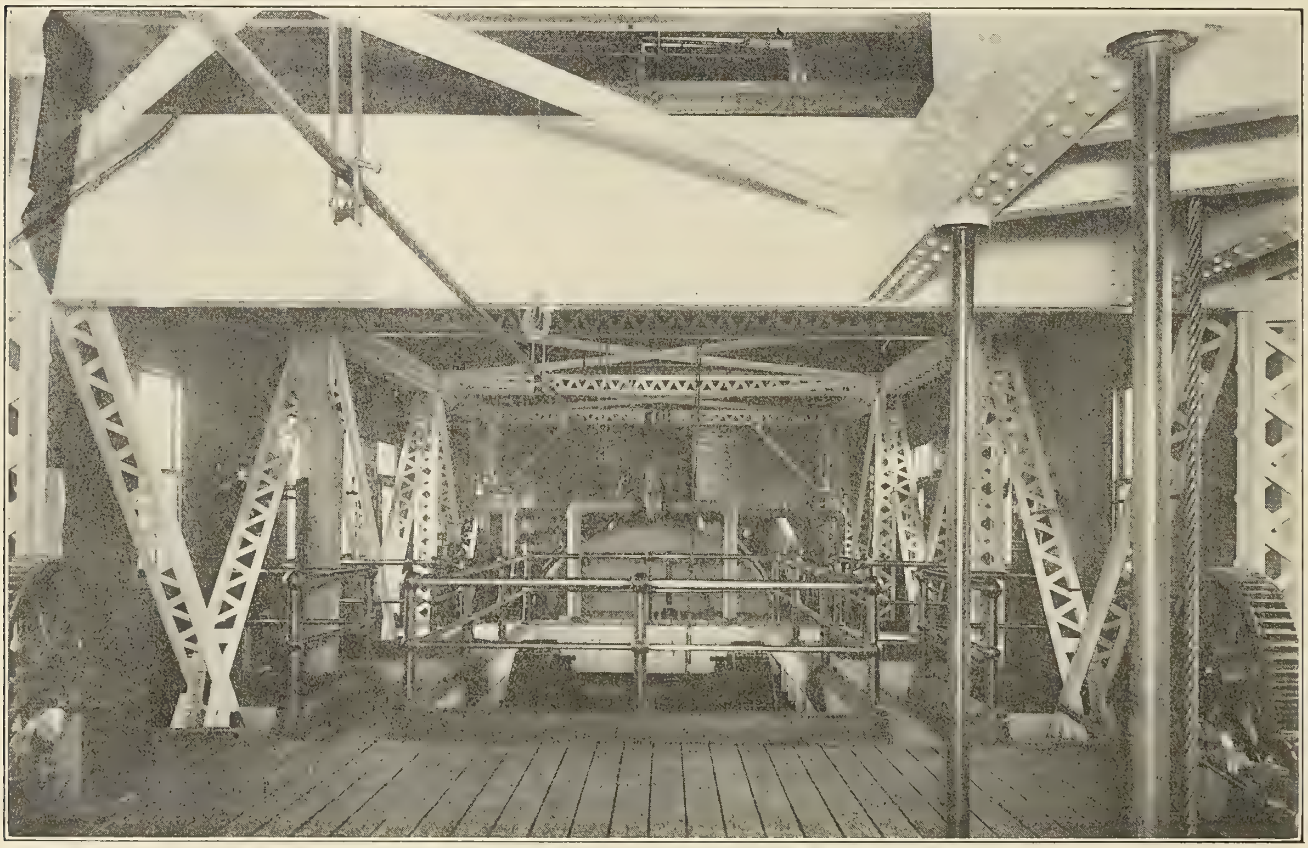


FIG. 2.—MAIN DECK OF THE TOLEDO, LOOKING AFT FROM THE OPERATING PLATFORM.

On a dredge of this size it has been found advisable to use two stern spuds instead of one, as is usually done. The reason for this is that the hull is so large and offers so much resistance to the waves, wind and current that it is found necessary, in moving ahead, to raise up one of the trailing stern spuds and drop it in a vertical position while the other trailing spud keeps the dredge lined up in the cut. The dredge, therefore, while moving ahead and dropping the forward spuds ready to excavate, is kept in line by the dipper and one stern spud. With only one stern spud a few moments would elapse with no anchor at the stern. The engine for operating each stern spud is a twin-cylinder, single-expansion, horizontal engine, compound geared to a wire rope drum, from which the wire rope leads to near the foot of the spud. The spud drops of its own weight and is raised by the cable. When the spud is down the engine is thrown out of gear.

The boom is stepped in a steel center bearing located on a

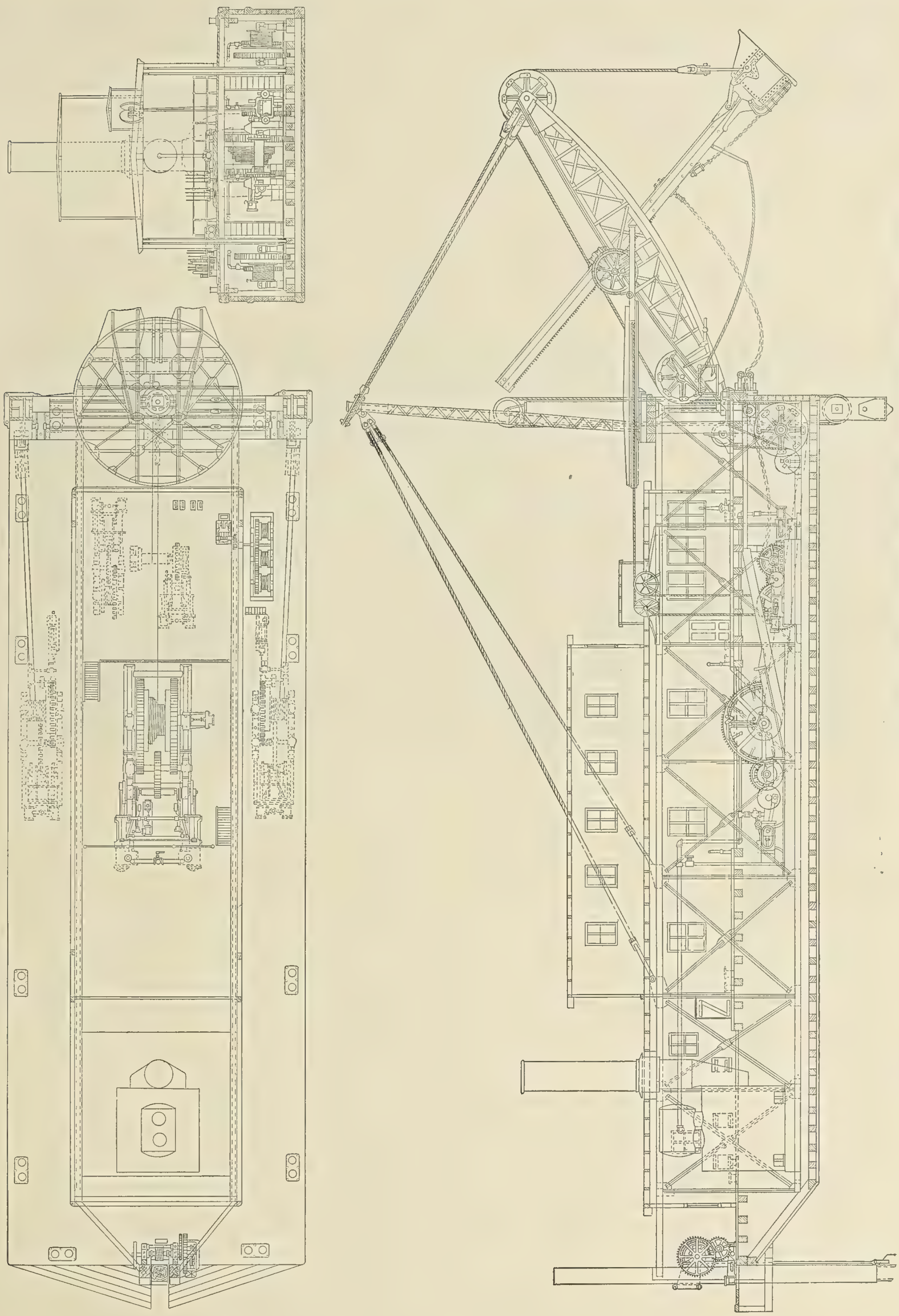


FIG. 3.—INBOARD PROFILE, DECK PLAN AND CROSS SECTION OF THE TOLEDO, SHOWING CONSTRUCTION OF HULL AND LOCATION OF DREDGING MACHINERY.

level with the main deck. The boom is entirely built up of structural steel, being shipped in two pieces for convenience. The swinging of the boom is effected by mounting the swinging circles on top of the steel truss, at such an elevation above the deck that by extending forward on both sides of the boom heavy structural arms, they take hold of the boom as near the central point as possible. The swinging ropes encircle the periphery of the swinging circle. From the circle they extend back to the vertical sheaves, which lead the rope down to the swinging drum located in the hold. An arrangement is made on the circle to take up any slackness of these ropes.

The dipper handle is of the usual construction with racks, which engage pinions on the shipper shaft on the boom, the revolutions of the shipper shaft being under control of the cranesman through the medium of two large brake wheels, carrying brake bands. The dipper has four teeth, and is of as heavy construction relatively as are the smaller dippers, enabling it to do extremely hard work. The dipper door latch is operated by means of a wire cable, which runs up the dipper arm and is fastened to the upper end of the arm. Where the cable passes through the boom it runs over a sheave on the boom and back to a sheave attached to a sliding cross-head; from there back to another sheave and thence to the top of the arm. The sliding cross-head is operated by a steam cylinder.

The A-frame legs are fastened to the deck by means of a universal joint. The legs are box girders, and the boom hangs from the A-frame collar by means of four cables. The A-frame has four back guys, distributing the digging strains through the hull, the strains in all being equalized at the A-frame head.

A dredge of this size requires very large scows, the one shown in the illustration having a capacity of 1,500 cubic yards.

The hull is of timber, but there are two steel trusses running the full length of the hull fore and aft with substantial cross trusses at the bow. These appear in the illustration.

Fig. 2 shows the main deck, looking aft from the operating platform. This view gives a good idea of the taste shown by the owners in fitting up the dredge. The quarters for the crew are on the upper deck, and consist of a large, well-lighted galley, forward of which are the sleeping rooms and bath.

The steam plant is first-class in every particular, and consists of a single-end Scotch marine boiler with three suspension furnaces, a surface condenser with horizontal air pump and centrifugal circulating pump, feed-water heater, the feed pumps, the filters, fresh water tanks and an electric light unit.

The levers, which are led to the operating platform, located forward on the main deck, are: For the main hoisting engine —reverse, hoisting clutch, brake and throttle; backing engine—backing clutch and throttle; for the swinging—reverse valve and brake; for each forward spud—reverse lever, brake and clutch. A cranesman operates the dipper door latch cylinder and the friction discs on the shipper shaft. The stern spuds are operated by a man on the after deck in obedience to signals from the runner. Wherever any force is required the levers at the operating stand simply operate the valves of steam cylinders, which are connected to the mechanism governed by the lever. In this way there is less fatigue to the operator of this dredge than is usually the case on a 1-yard dredge. It will be seen that with a scow on one side of the dredge being loaded, the entire dredge is controlled by four men; namely, the dredge runner, the cranesman, the stern spud operator and the operator in charge of the scow winches. In addition to these men the crew consists of a captain, the oilers, water tenders, firemen, deck hands and cook.

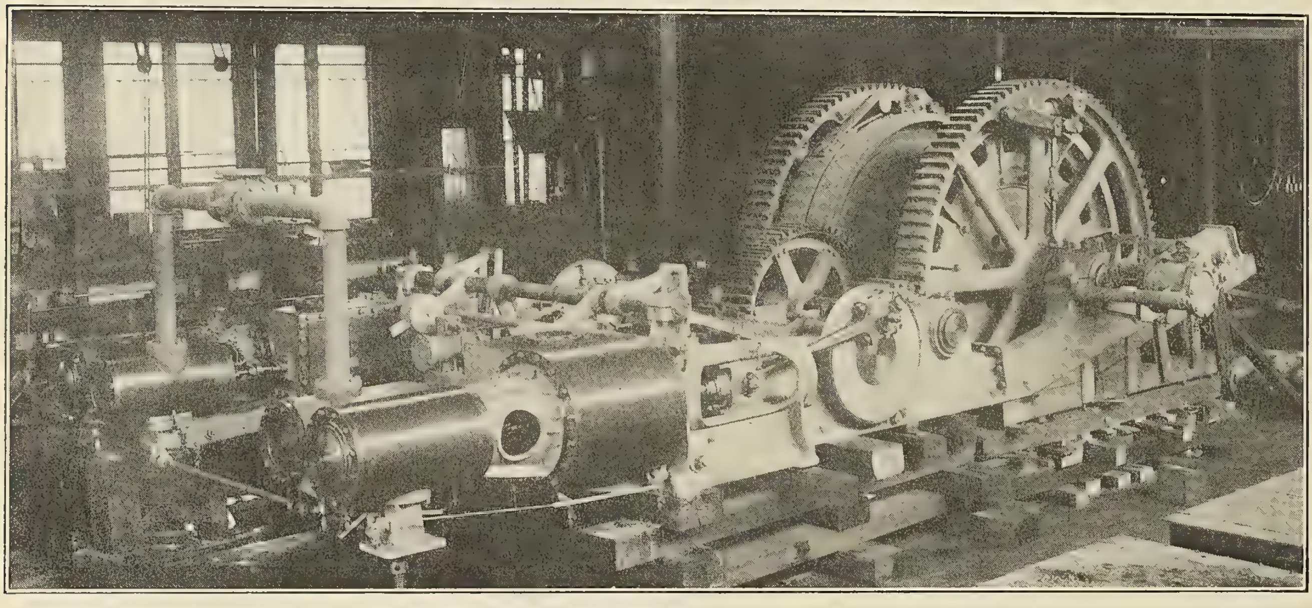


FIG. 4.—MAIN HOISTING ENGINES OF THE TOLEDO.

The dredge is capable of digging a dipper load each minute. This would, theoretically, amount to a capacity of 900 yards per hour, but it is, of course, necessary for the dredge to move up in the work, and there is considerable loss of time in getting scows alongside, so that this capacity is cut down to from 500 to 600 yards per hour, and the average over long periods will run down to perhaps 350 yards per hour on account of the delays due to heavy weather, most of the work being in a very exposed position.

The deck winches for warping the scows have three drums, one for a stern line, one for a bow line and one breasting line. About the deck are placed spools, bitts, etc., for convenience in leading lines. Under the main deck aft are the coal bunkers.

Practically all of the castings on the dredge are steel castings of unusually high tensile strength, and each unit of machinery is self-contained, to the extent that it is mounted on heavy base castings, which are in turn bolted to the timber framework. This means that the machinery cannot get out of line and that the gears all mesh properly, giving long life to the moving parts and a minimum of breakdowns.

The fitting out and finish of the dredge throughout, both inside and out, have been given more attention than is usually the case, with the result that the appearance is very shipshape. This dredge was built by the Bucyrus Company, of South Mil-

waukee, Wis., for the firm of George H. Breymann & Bros., of Boston and Toledo. Owing to the great length of the boom and dipper handle, it is impossible to dig a shallower channel than 20 feet deep. For this class of work, however, this fact does not limit the use of the machine in any way. The spuds are set back from the bow a sufficient extent to prevent the dipper from interfering with the spud feet. The angle of swing is very large, considering the size of parts, amounting to 157 degrees.

SEA-GOING SUCTION DREDGER PHARAON II.

This suction dredger, which was ordered by the Suez Canal Company from Werf Gusto, firm A. F. Smulders, Schiedam, Holland, with a view to studying exhaustively the problem of suction dredging and pumping in connection with the various kinds of soil which are met with in the canal, and which vary from soft mud and loose sand to stiff clay, hard marl, and even chalky rock, is fitted with a force pump and a patented cutter head, and is propelled by triple screws.

The principal dimensions of the dredger are as follows:

Length	170 feet
Breadth	30 feet
Depth	11 feet 6 inches
Draft	9 feet 2 inches
Dredging depth	39 feet 6 inches

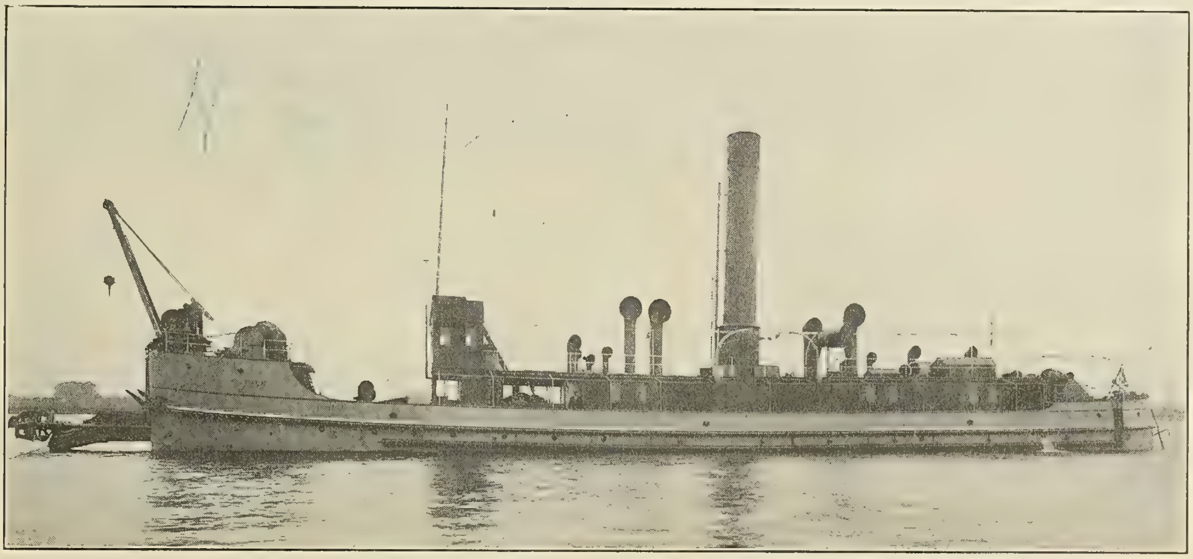
The vessel is provided with five compound engines aggregating 1,250 indicated horsepower. Two of these engines are intended to drive each one propeller or each one of the sand pumps. The third engine drives a central screw, and the fourth and fifth engines move the cutter head. The vessel is further provided with three steam winches, a dynamo engine for lighting the dredger by electricity throughout, and a 10-ton steam crane placed at the bow, intended to facilitate the handling of the cutter head and the suction pipe mouth piece.

Steam for all the above named engines is supplied by two marine boilers having each a heating surface of 2,050 square feet and a working pressure of 120 pounds per square inch gage.

The dredger has two sand pumps, which may work in parallel or in series. The suction pipe is mounted on a strong ladder placed in a central well forward. This ladder carries the cutter and the cutter shaft, which is moved by tooth gearing located in the vessel. When sucking very hard soil the dredger is pressed forward against the front of the soil to be removed by means of the bow winch and the central screw already referred to.

The dredger is capable of sucking from a depth of 40 feet and of forcing the spoil away to a distance of 2,000 feet and a height of 20 feet. The forcing away is effected either athwartships at the starboard or port side through an elevated conduit ascending vertically from the dredger's deck or aft through a floating pipe line. The dredged material may also be discharged directly into barges moored alongside.

Since the *Pharaon* was designed to dredge all sorts of soil and to force it away under all possible conditions, she is necessarily a very complicated piece of work. It may be said that the results obtained have proved the possibility of working by means of suction dredging varieties of soil which it was formerly held could not be handled by suction methods.



SUCTION DREDGER PHARAON II., BUILT IN HOLLAND FOR THE SUEZ CANAL COMPANY.

GOLD DREDGERS.

Free alluvial gold, platinum and other minerals are found in almost every part of the world, and in most cases dredging is the cheapest and most expeditious means of recovering them. For this class of work a special type of gold dredge has been developed, a large number of which Mr. Arthur R. Brown, of 54 New Broad street, London, has supplied to various parts of South America, Africa, Russia and Siberia. These gold dredges are capable of treating an enormous quantity of ground at a very small cost. The gravels are dredged, in many cases, from a depth of 50 feet, passed through a screen onto tables on which the gold is deposited, and the debris stacked behind the dredge for a total cost of about 2 cents (one penny) per cubic yard. A view of these dredges, while under construction at the builder's works in England, is shown in Fig. 1. This is the sixth gold dredge which Mr. Brown has supplied to Tierra del Fuego, and it was guaranteed to have an actual working capacity of 2,000 cubic yards per day, dredging from a depth of 45 feet below the water level. It is fitted with built-up steel buckets of six cubic feet capacity, the machinery is driven by a compound surface condensing engine of about 80 indicated horsepower, and the boiler is of special design to burn peat fuel. These dredges work day and night, being lighted by electricity generated on them. The dredge, after complete erection at the builders, is taken to pieces, shipped to its destination, and then re-erected.

When the dredge is erected, all of the machinery is covered in by a corrugated iron house, as shown in Fig. 2, which is a view of a similar dredge at work in Tierra del Fuego. Fig.

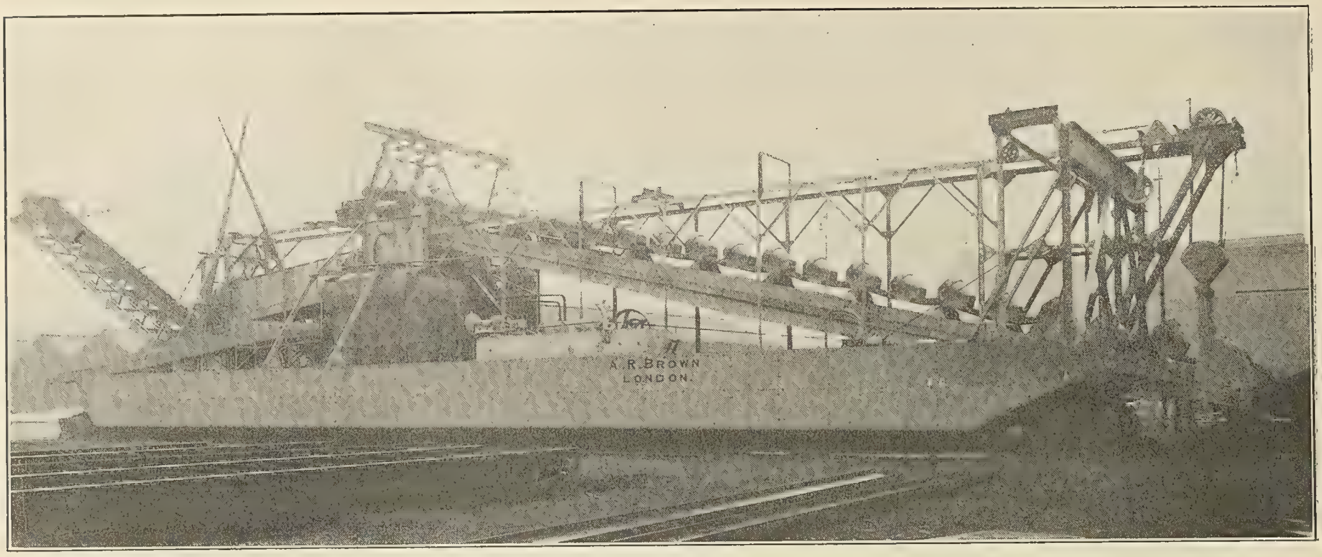


FIG. 1.—GOLD DREDGER UNDER CONSTRUCTION AT THE YARDS OF A. R. BROWN, LONDON.

2 is of peculiar interest, as it shows the dredge working before the ice has melted. In the winter the dredge is frozen up, but as soon as the ice melts sufficiently to enable it to be broken round the dredge, dredging can be resumed. The illustration shows men on the ice, which was 3 feet thick, breaking it round the sides of the dredge; these dredges have worked continuously all through the summer season, averaging 23 hours per day, and are paying handsome profits on ground which contains only 11.5 cents (5¾ pence) worth of gold per cubic yard.

Where the ground to be dredged is deep, or banks above the water level have to be dredged, it is necessary to use a screen and an elevator dredge, similar to those shown in Figs. 1 and 2, but in cases where the dredging depth is not great a simpler and cheaper form of dredge can be used, known as a sluice-box dredge, in which all of the material dredged passes down the sluice box direct from the buckets without screening or elevating. The depth to which a dredge of this kind can work depends on the height to which the tailings stack without touching the end of the sluice; in most cases gravels occupy one-third more space or height when stacked, consequently if a dredge is dredging 20 feet of ground level with the water the tailings will stack 10 feet above. A sluice box cannot be conveniently arranged to deliver more than about 8 to 10 feet above the waterline and, therefore, when the tailings stack to a greater height it is more convenient to have a tailings elevator.

Some exceptionally good returns have been obtained from small sluice-box dredges. A small prospecting dredge, with buckets of only 2½ feet capacity, which Mr. Brown supplied to West Africa, has been averaging 300 ounces per month, the total cost of the whole outfit being only $14,600 (£3,000). Considering the size of this dredge, the return is exceptional, but, of course, larger dredges have returned very much more. For instance, two dredges supplied by Mr. Brown to a Russian company in the Urals (Siberia) returned from April 9 to October 25, 1909, $353,275 (£72,555) worth of platinum. These two dredges are very powerful 7-foot bucket dredges,

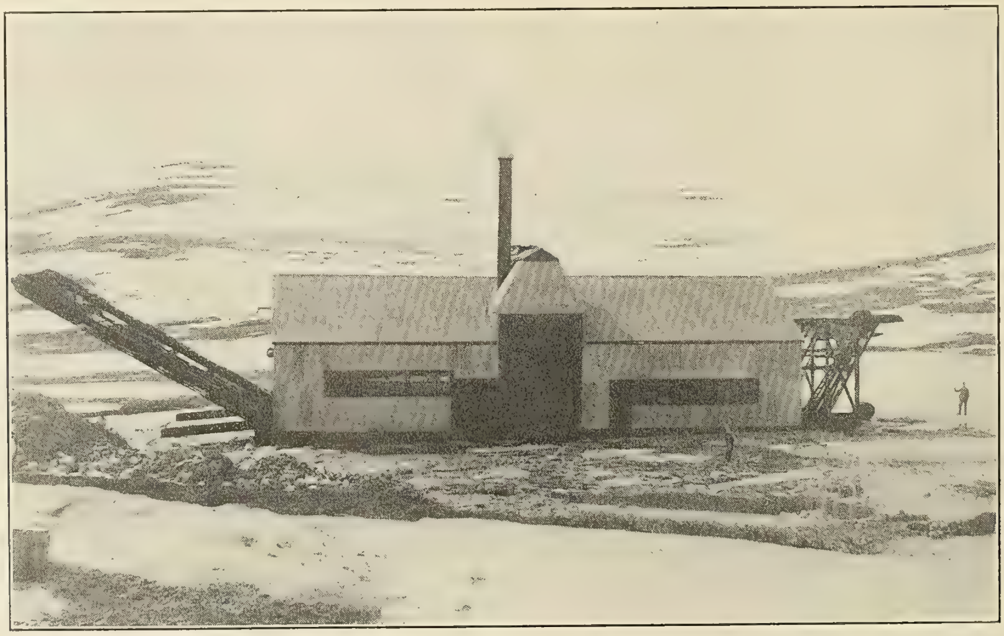


FIG. 2.—ONE OF BROWN'S GOLD DREDGERS AT WORK IN TIERRA DEL FUEGO. THE ICE IS 3 FEET THICK AROUND THE DREDGER.

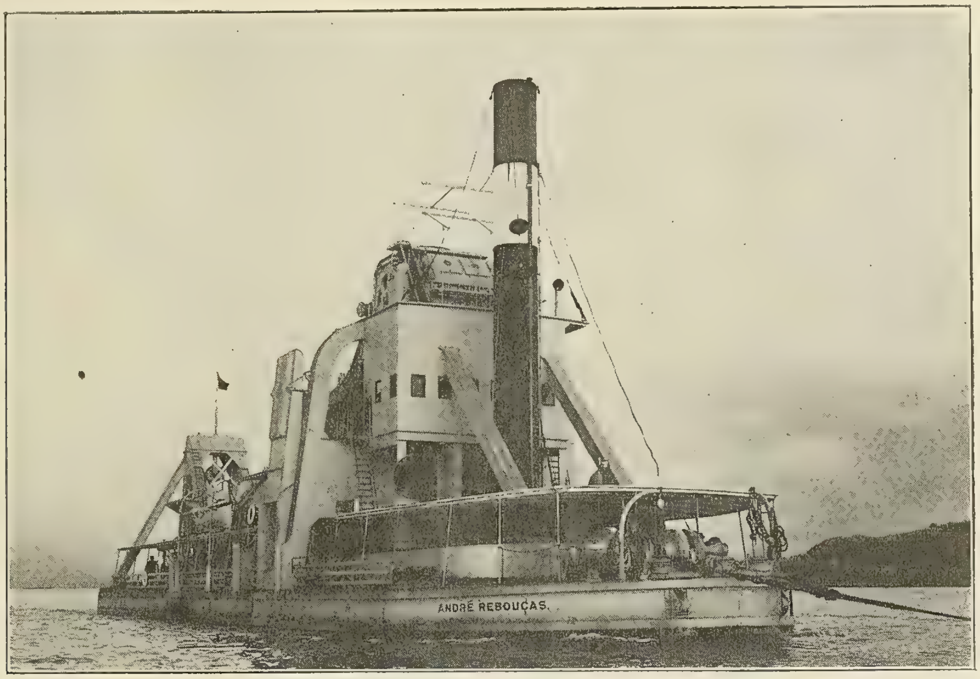
with special buckets for dredging through stiff clay, and also special arrangements for breaking up the lumps of clay in the screen. The total cost of the two dredges erected on the claim in Russia was $121,660 (£25,000), so that in 6.5 months they recovered nearly three times their total cost. It is usual in Russia for the dredges to only work about five months of the year, owing to the ground being frozen up, but in the case of these dredges, due to an exceptionally mild winter, they have been able to work all through the winter, and are still at work. Owing to these splendid returns, Mr. Brown received an order from another company for a similar dredge at the end of December last, which he shipped to the Urals within ten weeks of receiving the order.

Mr. Brown has supplied a number of other gold dredges to Liberia, some of which are paying very well on ground worth only 12 cents (6 pence) per cubic yard, and that during a short summer season; a dredge can only pay under these conditions provided it is designed to do the greatest amount of work on the least expenditure for fuel and repairs.

Gold dredges, although similar to harbor dredges in so far that they raise the material by means of a chain of buckets on a ladder which is raised and lowered by means of a winch, require special experience only obtained from actual working before they can be designed to do their work in the most efficient manner. Every gold dredge should be specially designed to suit the special requirements of the ground where it has to work. It is, therefore, a fatal mistake to supply gold dredges of a stock pattern, and a failure is sure to result if dredges are supplied unsuitable for the ground where they have to work.

For gold saving the suction dredge in many instances is not efficient; the pump not only requires very much more power to raise the same amount of material than the bucket, but if the surface of the bottom is uneven the gold is not lifted but is left in the crevices or hollows. In certain cases, however, a suction dredge is the best and most convenient type, as in a place in South America, where the tailings from a disused Spanish mine were found to have been washed into a large hole in a river bed. In this case Mr. Brown supplied an electrically-driven silt pump, mounted on a floating pontoon, which pumped these concentrates through 300 feet of floating pipe into cyanide tanks on the river bank. The capacity of the cyanide plant was only about 100 tons a day, but as the value of the gravels pumped amounted to over 2 ounces to the ton, the returns have been exceptionally good.

Mr. Brown is also building a special design of small bucket dredge, costing only a few hundred dollars, for dredging canals, swamps, and clearing out lakes or ornamental ponds, designed for transport in small pieces, the motive power being either gasoline (petrol) or kerosene (paraffine) motor or steam. The cheapest motive power, however, is producer gas, and in most cases where charcoal can be made it has been found to be the most convenient for use on a dredge. The gold dredges in Burmah are working most successfully with producer gas plants, the charcoal being purchased from the natives; in South America, at altitudes where no wood could be obtained, charcoal has been made out of a scrub growing a few inches above the ground, and gold dredges have worked there with producer gas with as low a consumption as one pound of charcoal per indicated horsepower per hour. The cost of the producer gas plant is not more than a compound condensing engine and boiler of the same power.



NON-PROPELLING BUCKET DREDGER ANDRÉ REBOUCAS.

André Rebouças.

We illustrate herewith a powerful bucket dredger, the *André Rebouças,* constructed by Lobnitz & Co., Ltd., Renfrew, Scotland, for the port of Para. This dredger was ordered March 11, 1909, the keel was laid April 11, and the vessel was ready for trial July 9, 1909; thus she was completely built and delivered within four months from the time of passing the order, a feat which is considered a record in rapidity of construction for this class of vessel.

The dredger is of the non-propelling type, very stiffly and powerfully constructed for dredging to a depth of 46 feet below water level in hard material, for which purpose the 600 horsepower dredging engines are situated high up near the top of the tumbler, and their gearing is designed in so simple a manner that one may say they practically act directly upon the buckets, and thus work with the greatest possible efficiency in dealing with hard material. The huge shaft of the

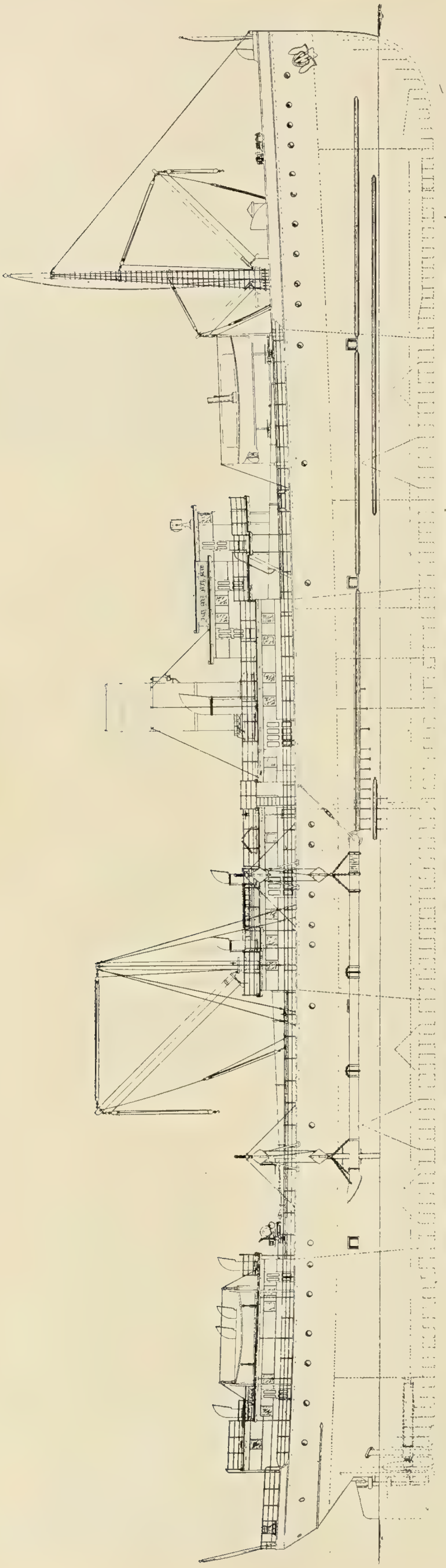


FIG. 1.—SEAGOING SUCTION DREDGE GALVESTON, BUILT BY THE MARYLAND STEEL COMPANY FOR THE ENGINEER'S DEPARTMENT OF THE U. S. ARMY.

tumbler over which the buckets turn at the top is of solid steel 19½ inches in diameter, similar to that of the great dredger *Péluse,* owned by the Suez Canal Company. All the gear wheels have their teeth machine cut from the solid steel.

SEA-GOING SUCTION DREDGES.*

BY THOMAS M. CORNBROOKS.

During the past five years the engineers' department, United States army, have contracted for a number of sea-going suction dredges. These have been of varying sizes, ranging from 166 feet to 300 feet long, the capacities of bins ranging from 1,000 to 3,000 cubic yards. As the design of all these dredges has been similar, the description of one will apply to all. The latest dredge is the *Galveston,* just completed at the works of Maryland Steel Company, Sparrow's Point, Maryland. As will be seen by the plates the dredged material is carried in two large bins, one forward and one aft of the machinery space.

In operating, the dredge is kept moving forward at a speed of about 6 knots, with the suction pipes dragging on the bottom. The material is sucked up by 20-inch centrifugal pumps and discharged into bins, through pipes and distributing chutes on top of bins. By means of gates in bottom and sides of these chutes it is possible to distribute the material evenly. As the bin fills the water is drained off by overflows through the sides. When the bins are filled the dredge proceeds to the dumping grounds and, opening the gates in bottom, drops the material. The gates are operated by means of a double-cylinder vertical engine through worms and fixed nut on vertical rods.

The officers and crew have commodious quarters in houses on deck and on the lower deck forward and aft.

The propelling machinery consists of two compound engines, steam for which is furnished by four single-ended boilers.

In trying these dredges, we have discovered that a very large rudder is necessary. This we ascribe to the shafts being so far outboard and the extreme fullness of the after body.

In Fig. 3 will be seen the curves of bending moments, etc., and equivalent girder, for the latest New York harbor dredges *Raritan* and *Navesink.* It will be noticed that the neutral axis of girder is very low, showing that the material is not distributed to the best advantage.

The bending moment for hogging works out $\frac{L \times D}{47.34}$, and the stresses, tension in sheer strake, 4.22 tons; compression in keel, 2.73 tons.

On the two dredges, *Ancon* and *Culebra,* built for the Isthmian Canal Commission, we located sights and measured the deflection under load. On loading for the first time, a deflection of 5/16 inch in 200 feet was recorded. This returned to within 1/16 inch of original marks when the load was dumped, which would indicate that the structure is amply stiff.

On these dredges we also conducted inclining experiments, memoranda of which are given below:

Draft forward, 10 feet 4 inches.
Draft aft, 11 feet 9 inches.
Displacement, 2,375 tons.
Conditions:
- Bilges, dry.
- Water tanks, full.
- Boilers, full.
- Workmen on board, 30.
- Bunkers, half full.
- Hopper gates, open.

G. M., 7.187, as inclined.

* From a paper read before the American Society of Naval Architects and Marine Engineers, New York.

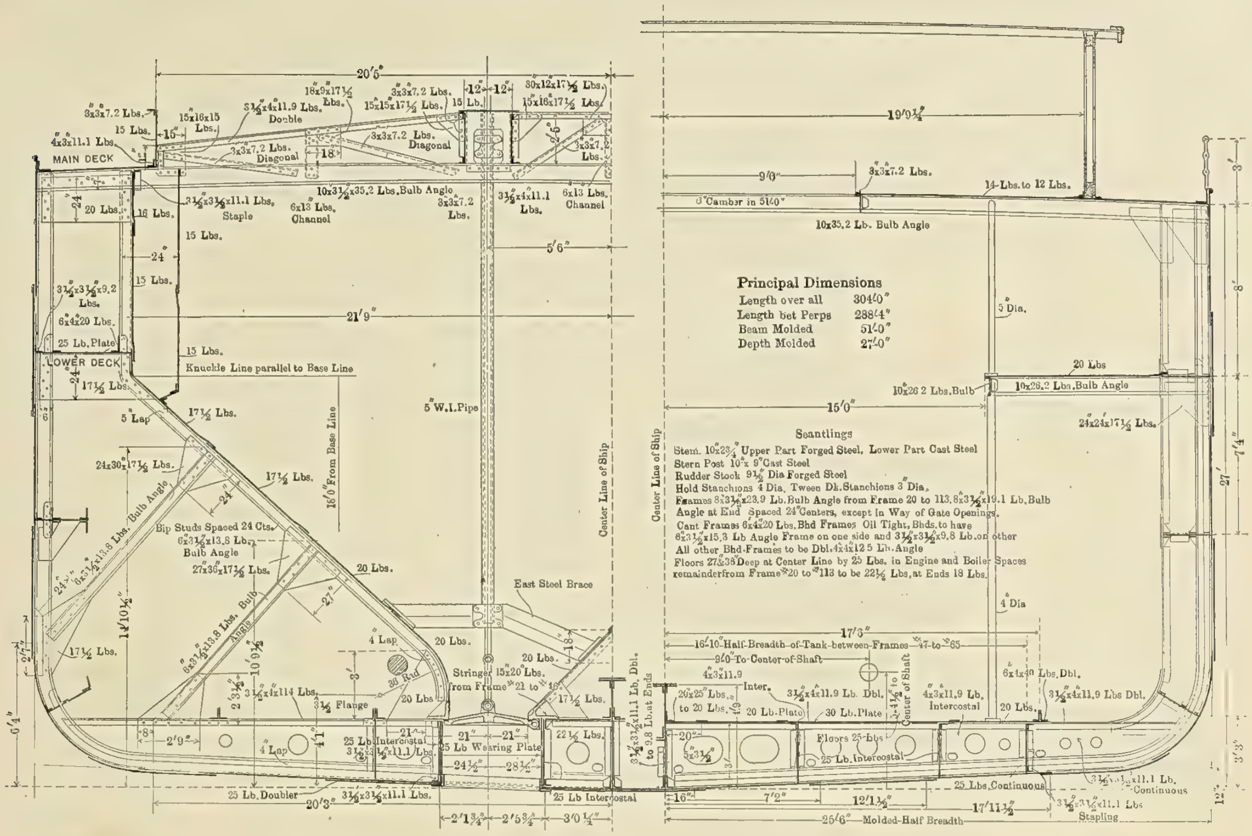


FIG. 2.—SECTION THROUGH AFTER BIN AND MIDSHIP SECTION OF THE GALVESTON.

Trans. B. M. = 20.4 feet.
Trans. C. B. = 5.53 feet.

25.93
7.19

18.74 = C. G. above base.

Loaded:

Hull, 2,375 tons.
Load, 3,085 tons (at 128 pounds per cubic foot).
Corrected C. of G., 18.14 feet.
Met. above base = 20.8
C. G. above base = 18.14

2.66 = G. M. loaded.

The percentage dredged depends on the quality of material, and ranges from 10 to 60 percent. The dredges start out at 5 A. M. Monday, summer and winter, and do not return to dock until noon on Saturday.

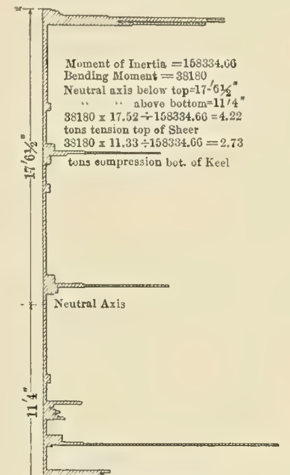


FIG. 4.—EQUIVALENT GIRDER.

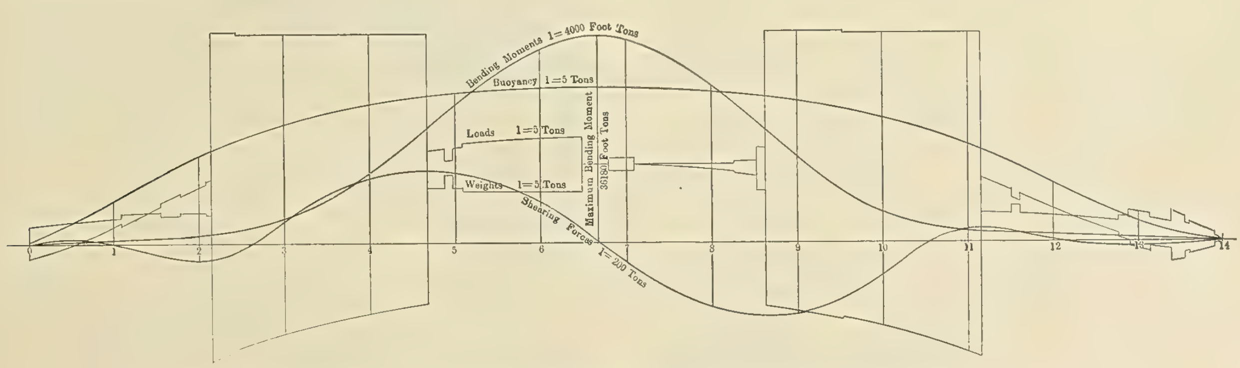


FIG. 3.—CURVES OF BENDING MOMENTS, U. S. DREDGES RARITAN AND NAVESINK.

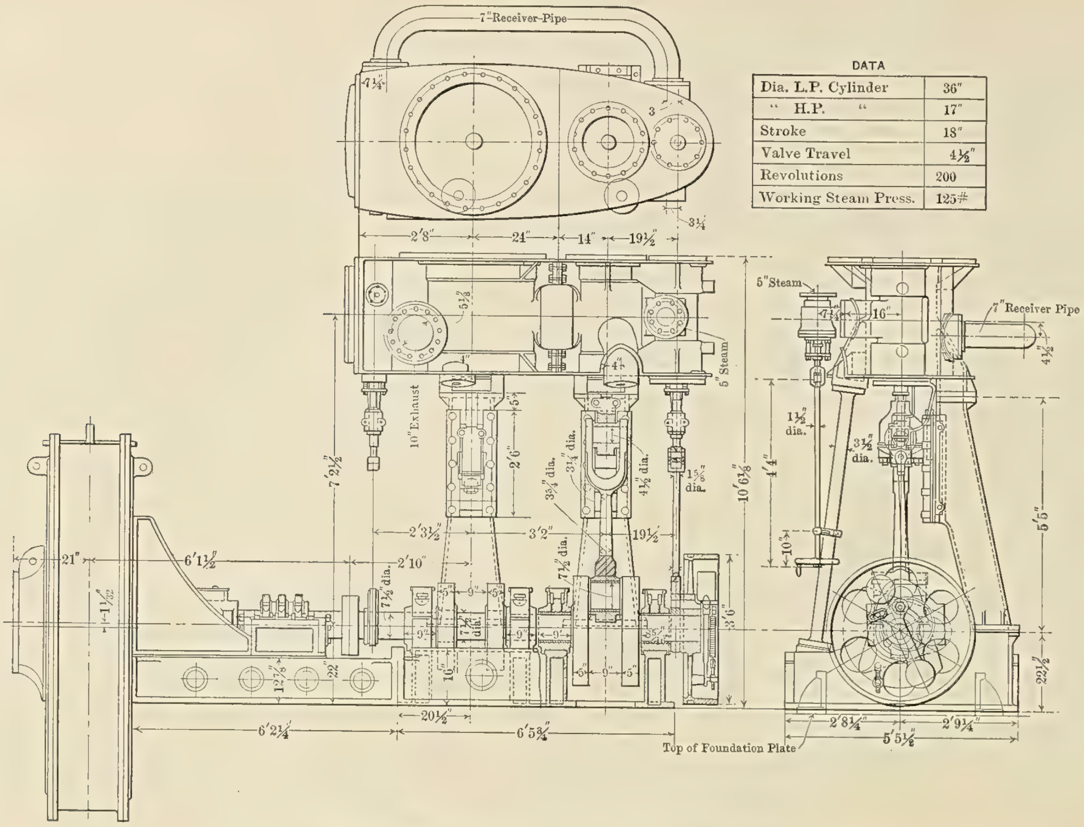


FIG. 5.—PUMPING ENGINE AND PUMP OF U. S. GALVESTON.

The *Manhattan* and *Atlantic* worked twenty-four hours per day from June 1, 1907, to Feb. 1, 1908, and only averaged forty hours per month lost time for repairs, bad weather and coaling.

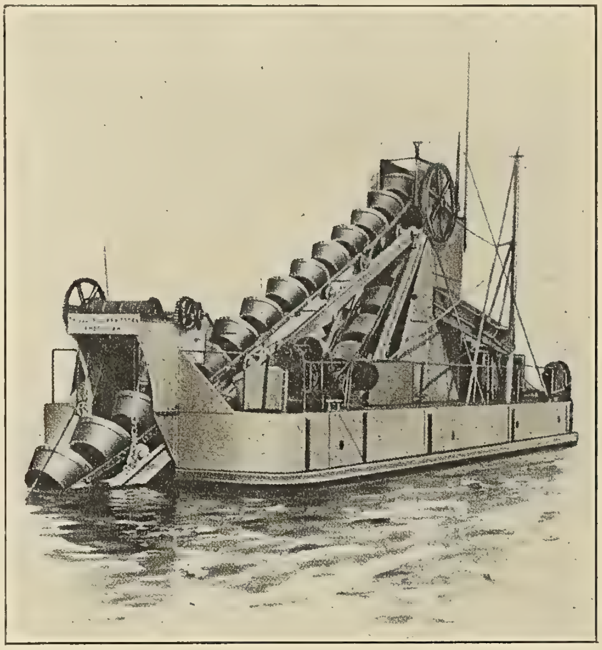
Below is the record of *Raritan* for ten days previous to July 31:

Number of loads, 44.
Cubic yards material pumped, 117,666.
Pumping time, 7,465 minutes.
Turning, 415 minutes.
Running to dump, 2,225 minutes.
Dumping, 490 minutes.
Returning to grounds, 1,685 minutes.
Pumped per minute average, 15.8 cubic yards.
Time at dock, 23 hours.
Minor repairs, 12 hours 20 minutes.

A Dutch Motor Dredge.

A dredger operated by a suction gas motor has recently been built by the Holland Motor Company, of Amsterdam, Holland. The vessel is constructed of steel and is 42.9 feet long, with a beam of 13.1 feet. The power plant consists of a single-cylinder Holland motor of 10-inch bore and 12-inch stroke, capable of developing 25 brake-horsepower at 280 revolutions per minute. Duplicate ignition, consisting of both a hot tube and a Bosch magneto, is fitted to the engine. Gas for the engine is developed by suction gas producer, using hard coal as a fuel. It is claimed that this installation is much simpler and more economical than a steam plant, and that it permits a reduction of the operating force, since only three men have to be employed instead of five.

The capacity of the dredger when working in soft ground is 786 tons for a ten-hour working day. When working in hard ground this is reduced to 590 tons. The weight of hard coal used during this period is 171 pounds, which in Holland costs about 48 cents (2 shillings). Assuming that the engine is working all day at full capacity, the weight of coal used per brake-horsepower per hour would be .71 pound, while the cost of fuel per brake-horsepower hour would be .2 cent (.1 penny). This figure is low, even for a suction gas motor, but it must be remembered that coal costing only $6 (25 shillings) per ton is being used.



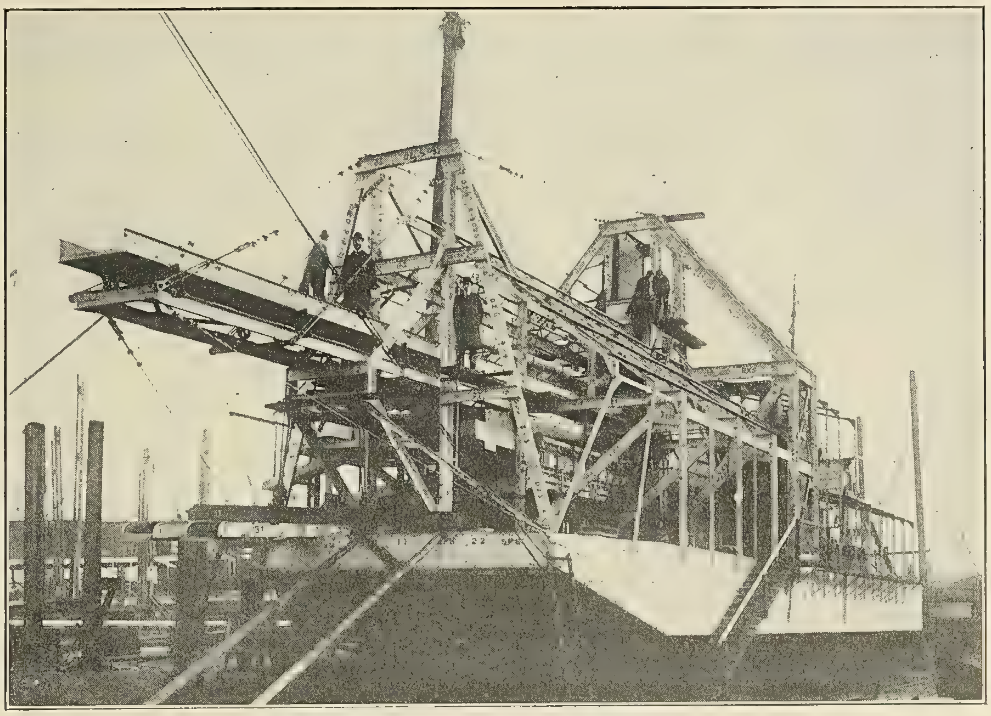
SUCTION GAS MOTOR DREDGE.

The British navy estimates for the present year call for five battleships of the dreadnought type, five protected cruisers of 25 knots or over, twenty destroyers, a number of submarines, and two floating docks.

A NEW TYPE OF GOLD DREDGER.

The gold dredger shown herewith is one of five similar dredgers built by Messrs. Lobnitz & Co., Ltd., Renfrew, Scotland, during 1909, all of which were fitted with what is known as the patent propulsion screen, a device designed and patented by Messrs. Lobnitz & Co., Ltd., to obviate the use of costly revolving screens and elevators. It is claimed that with the propulsion screen the gravel is much more efficiently treated, and is discharged as high as required behind the dredger.

The dredger shown in the illustration was built to the order of the Inambari Gold Dredging Company, Ltd., under the direction of the company's consulting engineers, Messrs. Ider & Henderson, of London. After being erected at the builders' works, the dredger was dismantled and shipped to Mollendo, and thence by rail to Tirapata. From Tirapata to the claim on the Inambari River the transport had to be done by mules, owing to the mountainous character of the country. For this reason the bulk of the material used in the construction of the dredge had to be arranged so that the dimensions of the packages should not exceed 6 feet by 2 feet 6 inches, and also that the weight of each should not exceed 165 pounds. In a few cases when parts of machinery could not be reduced to this weight special carts were designed and shipped out along with the dredge to transport these special parts over the difficult roads.

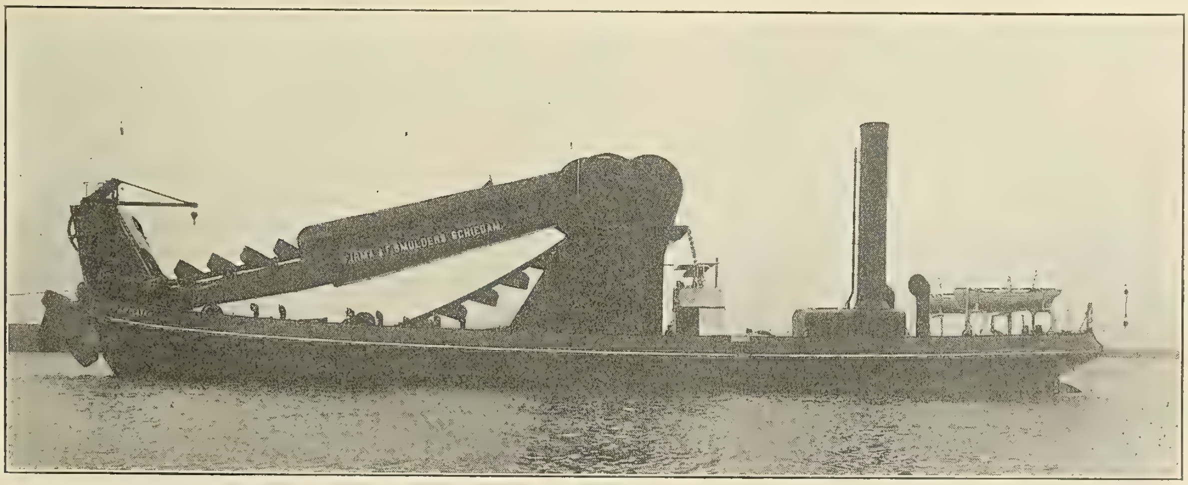


GOLD DREDGER FITTED WITH PATENT PROPULSION SCREEN.

The hull of the dredger is of steel, 102 feet long, 30 feet wide and 6 feet deep. The buckets have a capacity of 4¼ cubic feet each, and the dredge is capable of efficiently treating 1,500 cubic yards of gravel per day. The bucket ladder is arranged for a dredging depth of 35 feet below water level.

SEA-GOING TWIN SCREW BUCKET DREDGER.

The seagoing twin-screw barge loading bucket dredger *La Plata,* ordered from the Werf Gusto, firm A. F. Smulders, Schiedam, Holland, for deepening the port of Rosario, has



TWIN SCREW BARGE LOADING BUCKET DREDGER BUILT BY A. F. SMULDERS, SCHIEDAM, HOLLAND, FOR THE RIVER PLATE.

been built under special survey of the Bureau Veritas in order to receive the highest classification. The hull, which is divided into nine watertight compartments, has the following main dimensions: Length, 169 feet; breadth, 30 feet 6 inches; depth, 12 feet 6 inches. The well is aft, with a projecting ladder, so that the vessel can cut her own flotation.

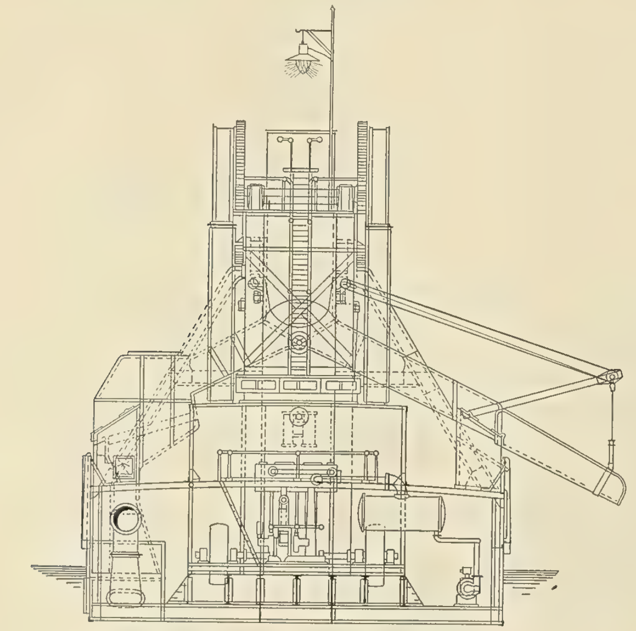
There are two main engines of the vertical compound type, developing 260 indicated horsepower each. Both engines drive the propellers, while each engine may separately drive the bucket chain. The vessel is further provided with five steam winches, namely: one bow winch, two fore-side winches, one aft winch, one ladder hoisting winch and one chute hoisting winch. The vessel is also supplied with a dynamo engine, and the lighting is by electricity throughout.

All of the main and auxiliary engines are supplied with steam by two marine boilers, each having a heating surface of 1,290 square feet and a working pressure of 120 pounds.

Dredging may be effected to a depth of 43 feet, and the effective output reaches about 650 cubic yards an hour. After having been submitted to exhaustive trials on the river Maas, the dredger traveled to the River Plate under its own steam.

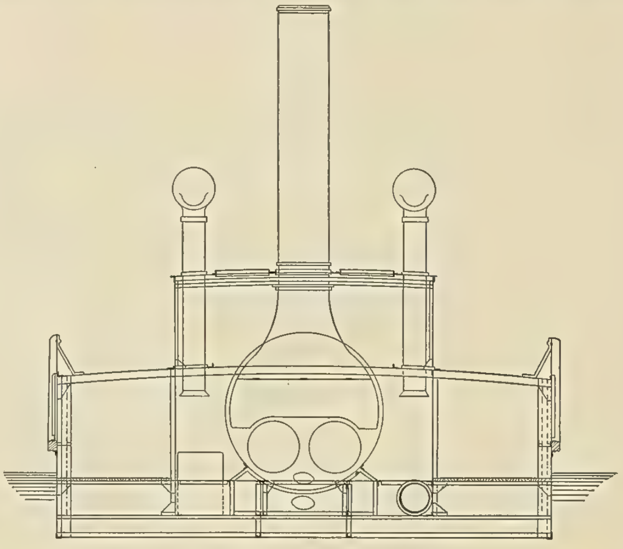
THE BUCKET AND PUMP DREDGER BRAILA.

Increasing traffic on the lower Danube recently led the Roumanian government to seek a more powerful dredger than those which had hitherto been available on the river. It was first planned to have constructed a large suction dredger with cutter arrangement. The principal object of this design would have been to enable the dredge to operate at those points where temporary sand bars had been formed by the current and to clear away such obstacles to traffic in the shortest possible time, forcing the dredged material through a floating pipe line and depositing it outside the ordinary ship channel. Further consideration of the problem, however, showed that it would be better to secure a dredger of more general usefulness, which could also be used for some improvement and extension works in the harbor of Galatz. The nature of the harbor in that port, however, is such that it was considered doubtful whether a suction dredger, even when fitted with efficient cutting apparatus, could handle the work. Furthermore, it was desirable to have the dredger arranged for loading barges. As a result of the necessity of meeting these various requirements, it was finally decided to use a bucket dredger of the endless chain type arranged for loading barges, but also fitted with a powerful sand pump by which the material raised by the buckets could be forced away through a floating pipe line.



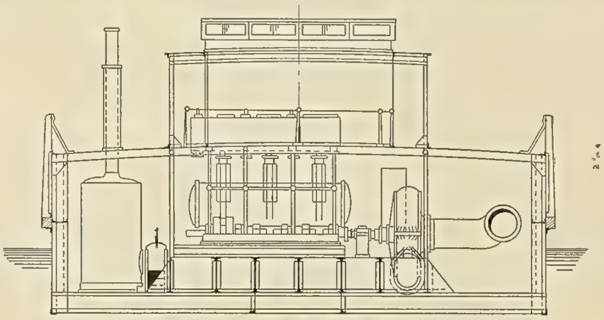
SECTION THROUGH MAIN FRAMING, SHOWING ARRANGEMENT OF CHUTES.

The contract for this dredger was placed by the Roumanian government with the Werf Conrad, Ltd., of Haarlem, Netherlands. The capacity of the dredger was stipulated in the contract to be 785 cubic yards per hour, and this was to be the actual output and not merely the digging capacity. The builders had to guarantee this output working in sandy clay and forcing the material brought up by the buckets to a distance of 1,300 feet with an elevation above the water at the end of the pipe line of 16½ feet. The trials which have been made with the dredger since she was completed have shown that she is capable of exceeding this guarantee by about 10 percent.



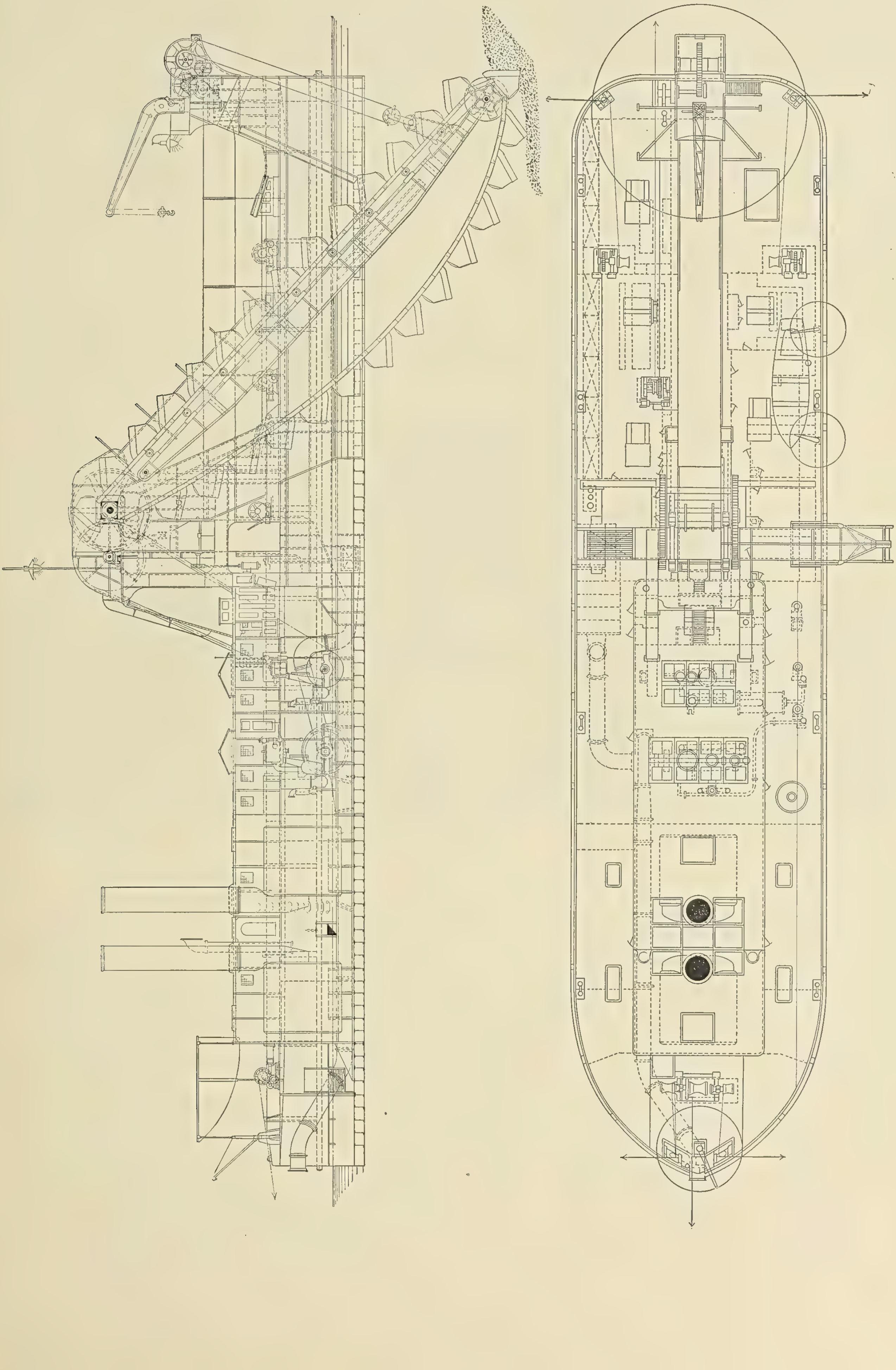
SECTION THROUGH BOILER ROOM.

The dredging depth of the vessel was fixed at 30 feet, so that she could be used for deepening the existing docks at Galatz. The principal dimensions of the dredger are: Length, 168 feet; width, 37 feet 6 inches, and depth, 12 feet 4 inches. It was stipulated by the government engineers of Roumania that the dredger in working order should not draw more than 5 feet of water. This is a very shallow draft for a dredger of this capacity, and it involved the necessity of building a relatively large hull in order to meet this requirement.



SECTION THROUGH ENGINE ROOM.

The dredger is fitted with two sets of engines, one of which is a vertical, surface-condensing, two-cylinder compound engine, which develops 385 indicated horsepower and drives the buckets, the connection between the engine and the bucket chain being by means of two belts. The other engine is of the triple expansion type, developing 500 indicated horsepower, and is used for driving the sand pumps. Steam is supplied at a working pressure of 160 pounds per square inch from two multi-tubular marine boilers having a total heating surface of 3,230 square feet. These boilers supply steam for both the main and auxiliary engines.



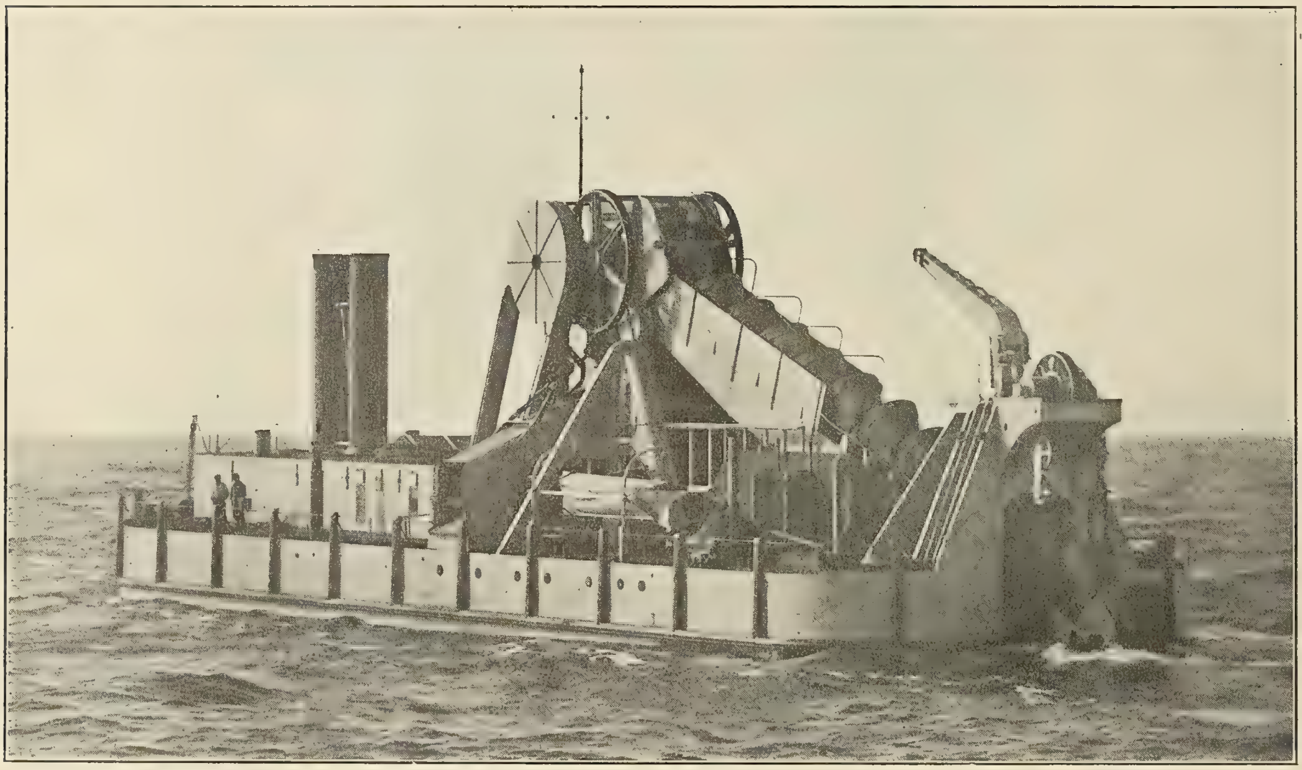
INBOARD PROFILE AND DECK PLAN OF THE BRAILA.

They are equipped for burning oil fuel, and although it is intended to use this kind of fuel as a rule, as most of the steamers on the lower Danube do, nevertheless coal bunkers have also been installed, and the furnaces can easily be arranged for burning either kind of fuel at short notice.

The auxiliary machinery includes two circulating pumps of the centrifugal type, each driven by a direct-connected, single-cylinder vertical engine. A steam-driven generating set is also installed in the engine-room to provide the necessary current for lighting the ship. There is also the usual equipment of auxiliary steam pumps for filling the boilers, emptying the bilges, washing the deck, etc., as well as injectors, bilge ejectors and a pumping plant belonging to the installation for burning liquid fuel.

Separate winches are located on deck for forward and side motions and for raising and lowering the bucket ladder. The roomy and well-ventilated cabins have been provided for the officers as well as excellent quarters for the deck hands and firemen. Comfortable quarters have been fitted on deck for the use of the government officers who have to stay on board the dredger. All of these different apartments, as well as the engine and boiler room, can be heated by steam, for which purpose a small donkey boiler has been placed on board.

The hull as well as the engines and boilers of this dredge have been built under Bureau Veritas Special Survey to the highest class for dredgers. The vessel was completed at the works of the Werf Conrad, at Haarlem, early in 1909, and after carrying out her preliminary trials she was towed out to the Black Sea, where her official trials were made on the Danube. These trials showed that the vessel was not only successful in every respect, but that her capacity exceeded the contract requirements of about 10 percent.



THE BRAILA BEING TOWED FROM HER BUILDERS' WORKS AT HAARLEM TO THE BLACK SEA.

three chains aft are worked from one combined three-barrel steam winch. The chutes are worked from a steam winch located under the main framing, and a set of direct-acting steam cylinders is fitted for working the door at the bottom of the central chute for delivering the dredged material on either side of the dredger into barges.

The buckets are of very strong design, and have a capacity of 35 cubic feet each. They are built up of steel plates and forged steel links, and are provided with hard steel lips. This construction was considered to be the best in this case, and to provide greater advantages than cast steel buckets, since great solidity and strength could be obtained with less weight than would have been required with a chain of cast steel buckets. This saving in weight was desirable on account of the shallow draft which, as has been stated, was stipulated in the contract.

The very light draft for which the vessel was designed has the enormous advantage that the dredger can be easily towed over sand bars and reach any place where a bar has been formed by the current. On the other hand, the size of the hull necessitated by this very light draft leaves ample room for spacious accommodations for the crew. Consequently, large,

A Broken Stern Gland.

We left our pier in New York bound for Liverpool one morning in May, 1909, in a ship which travels at the rate of 26 knots, but we had proceeded only a short distance when one of the shaft oilers reported to the engineers on watch that something was wrong in the starboard high-pressure room. I must mention that this ship was propelled by turbines. It appears that before leaving the pier the stern gland on the starboard high-pressure shafting had been screwed up a little, as it was admitting water into the bilges. Those who know anything of turbines will know that they start off at a high speed. A jet of sea water was running on the gland from a water-service pipe, but as it turned out this was not enough to keep it cool. The gland became warmer and warmer although more water was applied to it, until it gave off steam. Finally it cracked with a jar. We made two steel bands and bolted them together round the gland. The gland was watched by two men who did six-hour watches all the way home, and I am glad to say the job carried up all right to Liverpool, where it was repaired. F. J. N.

DIPPER DREDGE FOR MONTREAL CONTRACTORS.

A 1½-cubic yard dipper dredge has recently been built by the Vulcan Steam Shovel Company, Toledo, Ohio, for Laurin & Leitch, No. 5 Beaver Hall Square, Montreal, Que. The new dredge is at present being used to dredge a channel for the intake pipe to the crib which is being built in connection with the city of Montreal waterworks.

The hull of the dredge is 80 feet long by 40 feet wide and 7 feet deep, and was built on the ground after plans furnished by the manufacturers of the machinery. The main engines are double 10 inches by 12 inches, piston valve, reversible engines without links, the valves being so set as to give maximum efficiency in the go-ahead position. The crankshaft is of hammered iron, and the pinion is of cast steel with cut teeth.

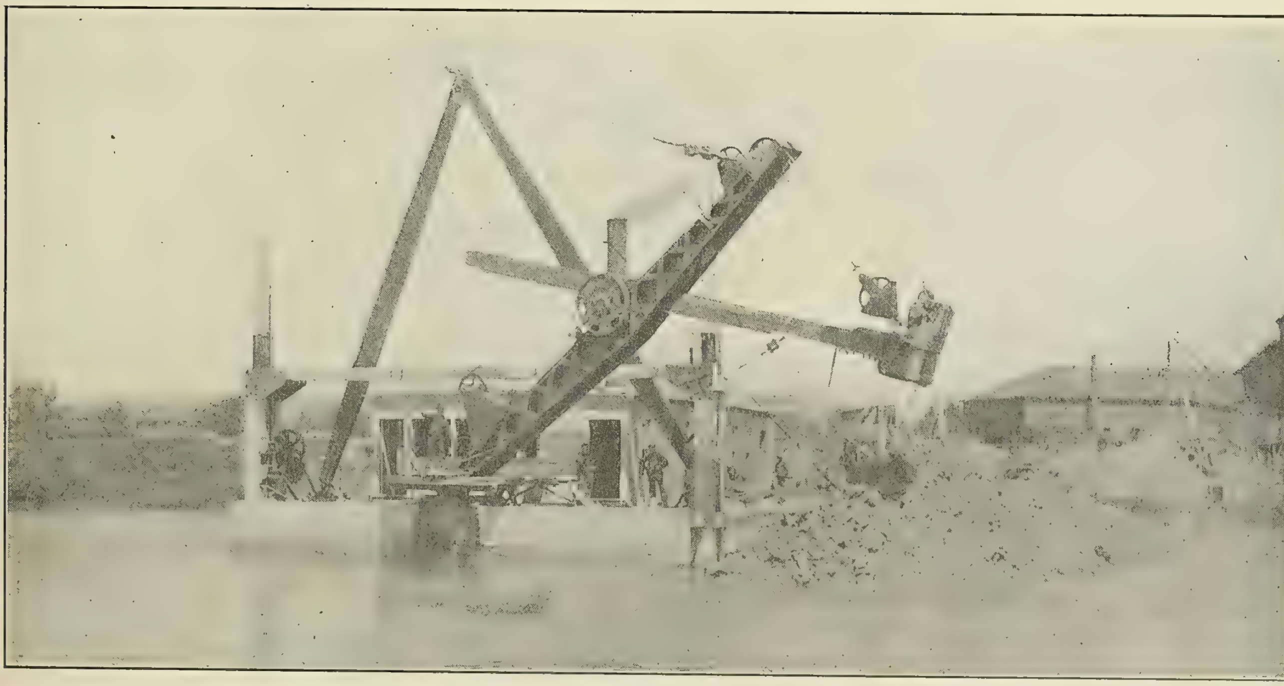
The hoisting gear is of cast steel with cut teeth. The hoist drum is of cast iron, brass bushed. It runs loose on the shaft, and has wide-faced flanges riveted to each end for friction and lowering brake bands. The drum has finished grooves for the cable. The hoist friction is of the outside band type, wood lined and controlled by a steam ram operated by a hand lever at the engineer's stand. The lowering brake is also of the outside band type, wood lined, and is controlled by means of a foot treadle at the engineer's stand. The drum shaft is of hammered iron supported in strong cast iron babbitted bearings with adjustable caps.

The swinging engines are 8 inches by 9 inches, duplex, slide valve, reversible engines, with the bed cast in one piece. The crank is forged and the crank-pin and cross-head pin bearings are of bronze. The swinging engine pinions are of forged steel with cut teeth. The intermediate gear is of cast steel with cut teeth. The swinging gear is of cast steel, with cut teeth, and is riveted to the drum. The swinging drum is of cast iron running loose on its shaft, and has finished grooves for the cable.

The backing gear is of cast steel with cut teeth, and is driven from the main engines. The drum is of cast iron, with brass bushings, and runs loose on the shaft. It is driven direct from the gear by means of an outside friction band, handled from the engineer's stand through hand lever and connections.

The bow anchors are raised by means of a rack and pinion, the pinion being driven through a train of gears and a steel sprocket chain with a friction device on a shaft under the deck, which in turn is driven by the backing shaft. The bow anchors are provided with strong cast steel locks for holding them at any desired depth. The stern anchors are of the walking type, with cradle and guide. These are operated by hand power. Two winches are provided on the deck, which are driven by gearing from the backing drum shaft.

The A frame is built up of channels, plates and bars, with a cast steel head, feet and steps. The head is provided with cast iron yoke brass bushed. The boom and back guide are of wire cable. The swinging circle is 16 feet in diameter, of structural steel with a cast steel brass bushed center, working in a steel step or base casting with a bronze collar between. The whole circle is thoroughly and substantially framed, and has proper provision for connection to the boom and to the swinging cable. The circle is carried at the deck level.



DIPPER DREDGE IN SERVICE AT MONTREAL, QUE.

The boom is of steel plates and shapes riveted up in the most substantial manner. The shipper shaft is of cast steel, and is furnished with brake-wheels 54 inches in diameter by 5-inch face, with wood-lined bands controlled by a foot pedal to the cranesman's stand. The boom is 38 feet long, center to center, and is stepped at the bottom in a strong steel casting, brass bushed, which works on a steel base plate with a bronze washer between. All hoisting and swinging sheaves are of cast steel, brass bushed, with pins of ample size to prevent undue wear. The dipper handle is of wood, steel armored.

The dipper is of 1½ cubic yards capacity, square, with four tool steel teeth, a cast steel back, cast steel lip, lugs and forged bail, braces and hinges.

The boiler is of the locomotive type, 66 inches in diameter by 14 feet long, covered with magnesia boiler covering. It is built for 125 pounds working steam pressure, and is supplied with water by means of an injector and steam feed pump.

Oil is supplied to all engines by means of a Hills-McCanna force-feed lubricating pump, insuring a constant and sufficient supply of oil at all times. All sheaves, bearings, etc., are fitted with dope cups of ample size. Each engine is also furnished with a hand oil pump and the ram and the pump are furnished with a lubricator.

It will be seen from the above description that the machinery is large enough to carry a 2½-cubic yard dipper for ordinary work, but inasmuch as the material at present being excavated is rock, the smaller dipper was substituted. The smaller dipper is more efficient for the present work.

NEW BUCKET DREDGERS FOR THE KAISER WILHELM CANAL.

Two bucket dredgers of the largest type afloat are being completed at the yards of Messrs. Sachsenberg Brothers at Rosslay (Anhalt, Germany) for the Imperial Canal Administration at Kiel. The dredgers are driven by steam engines, and will have an output of at least 17,660 cubic feet per hour while working uninterruptedly in compact sand, and with the buckets 70 percent filled as stipulated. The normal depth at which the material is dredged is about 40 feet; in this condition the bucket ladder has an inclination of 45 degrees to the horizontal. The point of suspension of the ladder can be shifted in order to attain a dredging depth of 46 feet. The bucket ladder is situated in a well, and in order to be able to dredge its own way projects ahead of the bow of the dredger about 15 or 16 feet. The dredged material is discharged in chutes, and received by barges lying at both sides along the dredger.

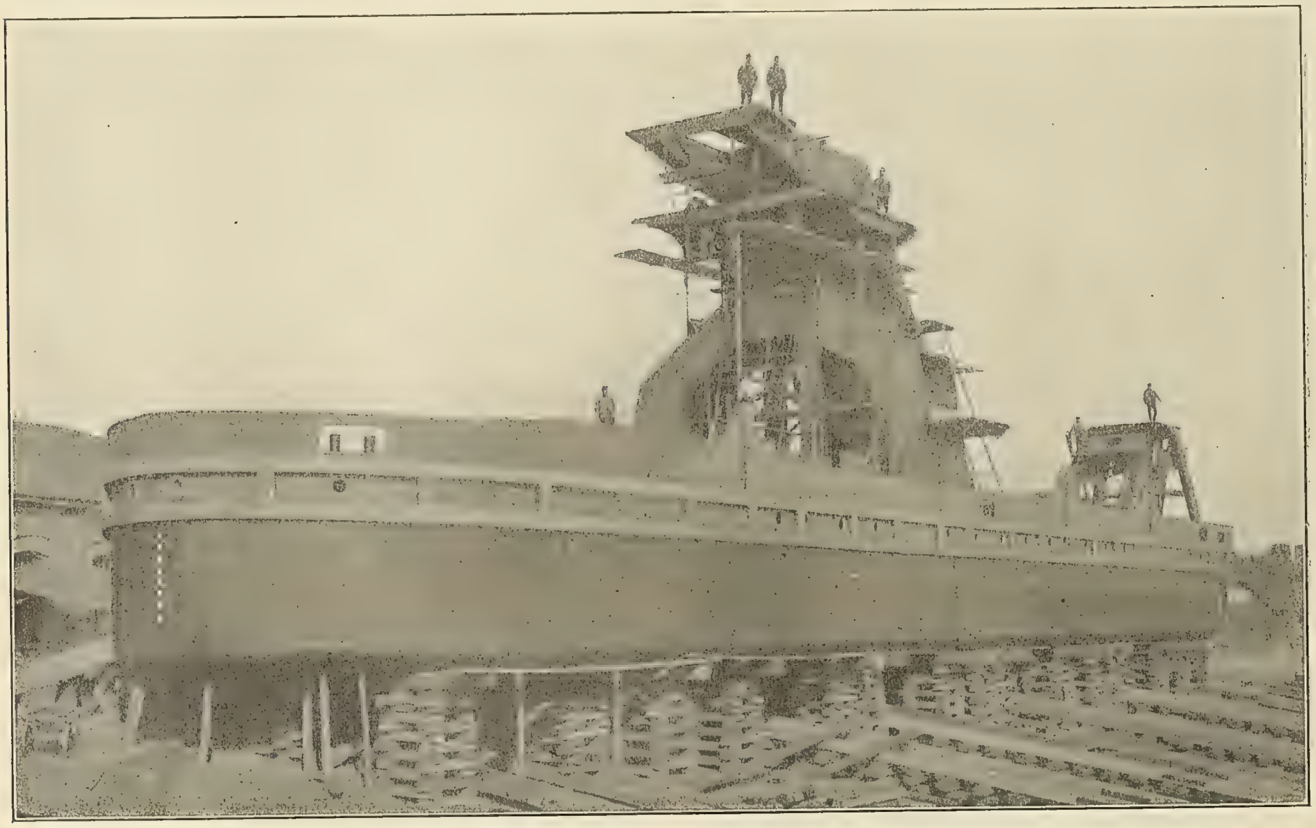


FIG. 1.—HULL OF NEW BUCKET DREDGER FOR THE IMPERIAL CANAL ADMINISTRATION AT KIEL, UNDER CONSTRUCTION AT THE BUILDERS' YARDS.

HULL.

The principal dimensions of the hull are as follows:

Length on load line	159.01 feet
Breadth molded	30.18 "
Depth, molded	11.48 "
Draft in working condition about	7.38 "

The hull is constructed of German mild steel, according to the regulations of the Germanische Lloyd Class 100 A. W. 4. The scantlings are indicated on the cross-section (Fig. 2). The riveting of the seams and butts of the outside plating and of the deck are overlapped. In order to distribute efficiently the strains on the engine and boiler foundations and the connections of the main-framing web frames, double reverse angles, extra deep floors, etc., have been provided. For the same reason a side stringer is constructed at about half the ship's depth on the outside plating. The deck is constructed of checkered steel of 3/16 inch thickness, and is well riveted to the beams. In order to maintain the buoyancy of the ship in case of severe damage of the outside plating of the well a gallery has been provided along it.

All around the whole vessel a double oak fender is fitted of 10 x 5 inches cross section, between strong angle-bars. Also vertical fenders of the same scantlings at every fourth or fifth frame. At four places on both sides the latter have been continued above the gunwale for about 6 feet 6 inches, and are efficiently connected to the ship's structure. The floor plates in the engine and boiler rooms and in the hold for the winches are made of checkered plates, which are easily removable for inspection of the bilges. In the galley and toilet the flooring is covered with cement tiles. In the other holds the flooring is of tongued and grooved yellow pine boards 1¼ inches thick. The walls of the cabins are paneled. The wooden linings are partially removable, in order to enable an inspection of the inner painting of the vessel. The rest of the lining of the bulkheads and of the deck is constructed neatly and efficiently of well-seasoned wood.

The following crew spaces have been provided: 2 cabins for the dredging masters; 1 cabin for the engineer; 1 cabin for the assistant engineer; 1 space for the two firemen; 1 space for the mate; 1 space for the cook; 1 space for 5 sailors. There is in addition 1 kitchen, 1 pantry, 1 magazine, 2 toilets, 1 lampstore, 2 cable stores, etc. The cabins and crew spaces are adequately fitted with simple furniture. Ample admission of light and air is provided by means of scuttles and skylights. The living quarters are designed to accommodate a double crew.

The superstructures over the engine and boiler holds are

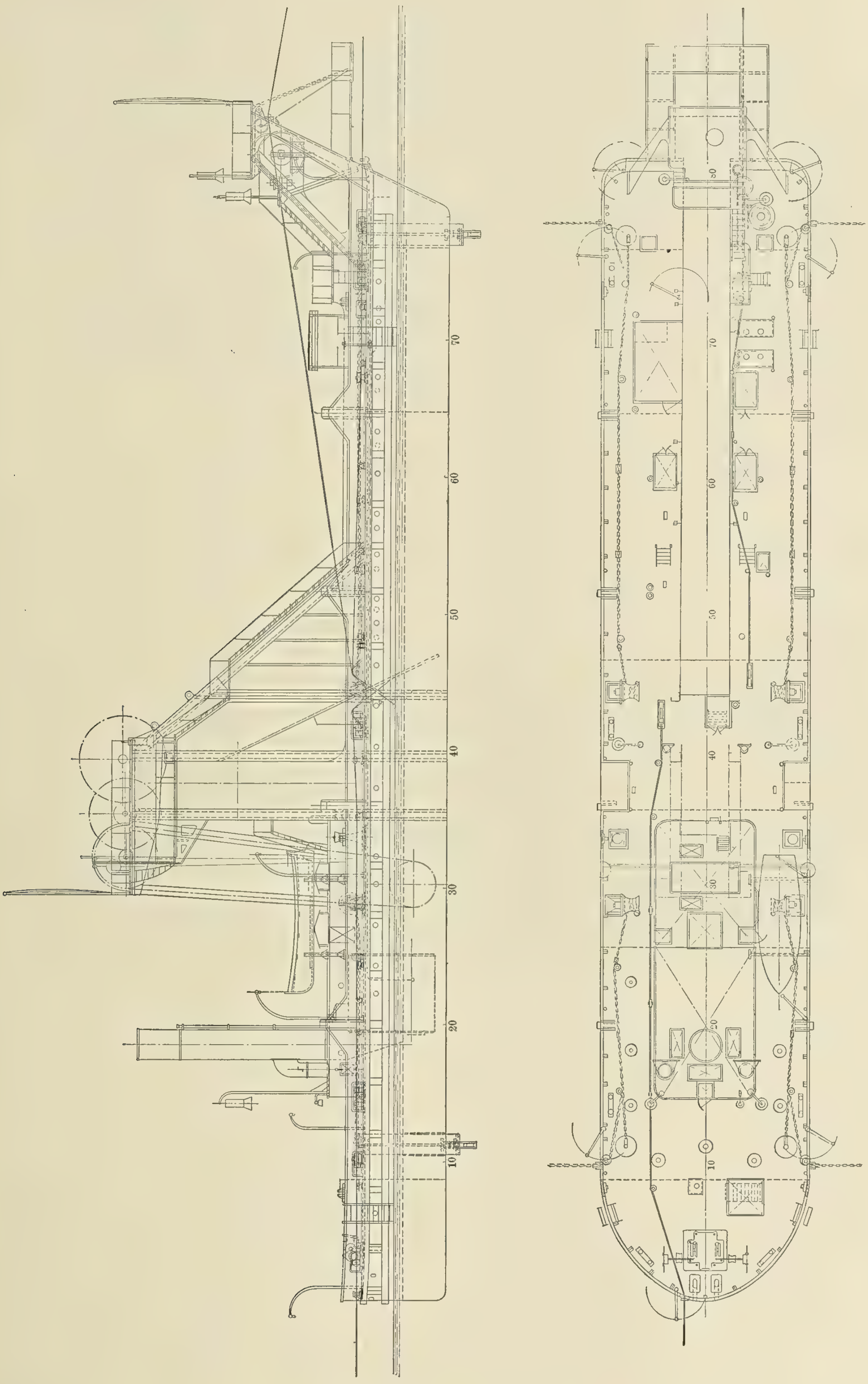


FIG. 2.—PLANS OF NEW DREDGERS FOR THE KAISER WILHELM CANAL.

constructed of plate and angle iron. The companions, deck-house, enginehold, skylights, etc., are made of teak, and all the fittings are of brass. Furthermore, two scowl ventilators have been provided, one of which is equipped with a winch for raising the ashes, etc.

A bulwark, with a railing bar, is constructed on both sides of the vessel and along the well; scuppers in sufficient number have been provided. The whole inner bottom of the vessel down to the bilges is covered with a layer of Portland cement, covering the heads of the rivets.

In continuation of the sides of the well two intercostal keelsons are constructed, and two intercostal side-keelsons are fitted. The hull is divided into ten watertight compartments by nine transverse bulkheads.

MAIN FRAMING.

The main framing consists of a solid plate and angle bar structure. On it the gearing for driving the bucket chain and the suspension of the ladder are erected. It is well connected to the hull by columns of plate and angle bar, which are continued to the floors, and by the lateral box-shaped discharging chutes. For access to the different gearings stairs and platforms have been provided. The lateral movable chutes have, when let down, an inclination of 30 degrees to the horizontal. They can be swung in by electric winches so far that they do not project over the fender. In order to enable a more perfect distribution of the dredged materials the exterior part of these chutes is again hinged. The length of the movable chutes and the height of the axis above the water level have been chosen so that barges of 21½ feet breadth can easily be loaded. By maneuvering a balanced removable flap, supported on springs, the spoil is conveyed through the chute to the barges lying on either side of the dredger.

The lower part of the ladder is suspended by means of a steel-wire tackle to the fore-framing. This is a plate and angle bar structure, adequately solid to sustain the shocks and to connect the two halves of the vessel. It is provided with the necessary platforms, stairs, etc., and a swinging crane of 2 tons lifting capacity is erected on it for repairing and inspecting the buckets, the lower tumbler, etc. A platform for sounding is hinged to the fore-framing.

THE BUCKET LADDER.

The bucket ladder consists of two plate girders strengthened with angle bars and rider plates, adequately stiffened and trussed. The ladder is suspended to an axle at the main framing, independently of the tumbler shaft, and has thirteen pairs of cast steel rollers for supporting the bucket chain. Along the sides of the bucket ladder, and at the lower rider plates, screens are fitted in order to prevent the dirt splashing on the deck. The ladder is guided by rubbing plates bolted to its girders and flat bars on the sides of the well. At the upper end of the ladder a regulating device for neutralizing the slack in the chain is provided, by which the ladder can be lowered or raised for about 2 feet 6 inches. Both tumblers are pentagonal and of cast steel, with renewable steel wearing plates.

BUCKETS.

In the chain are forty-three buckets, the details of which are very simple. The back, bottom and links are in one piece of cast steel. Only the shell and the lips are of mild steel riveted to the backs. The lips are made of special steel for obviating excessive wear. The capacity of each bucket is 30.63 cubic feet, and the pitch of the chain is 2.62 feet, which gives the buckets a favorable shape.

The links connecting the buckets are of mild steel, and all have interchangeable bushes of special steel. The pins also are made of special steel, and are prevented from turning by stops on the bucket links.

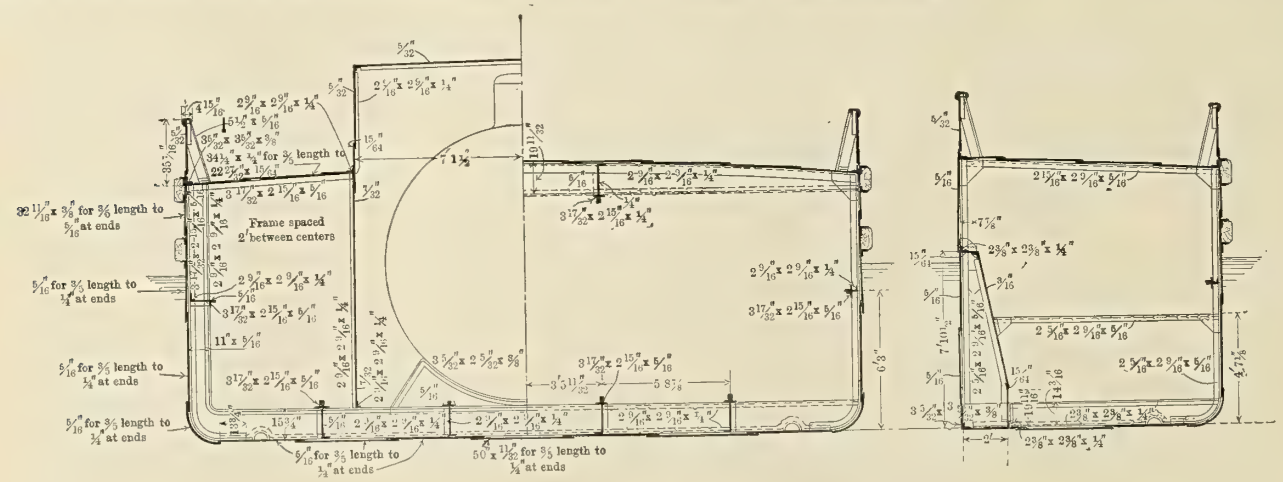


FIG. 3.—MIDSHIP SECTION SHOWING SCANTLINGS.

MAIN ENGINES.

For driving the bucket chain a vertical compound engine of special solid construction with surface condensation has been provided. The air and circulating pumps are actuated directly from the cross-head of the main engine, which develops in normal working condition and at normal depth of dredging about 330 brake-horsepower. The engine is equipped with Marshall valve gear, with an expansion piston valve for the high-pressure cylinder, and a flat slide valve for the low-pressure cylinder. The admission of the steam to the high-pressure cylinder is controlled by a Stein patent governor. The principal dimensions are:

Diameter of high-pressure cylinder......	13.44 inches
Diameter of low-pressure cylinder.......	22.40 "
Common stroke	16.00 "
Revolutions per minute..................	180

The condensing plant consists of a separate surface condenser, placed horizontally.

For driving the electric generator a vertical compound engine is directly coupled to the dynamo. It can work either condensing or exhausting into the atmosphere. It is controlled by a Stein patent crankshaft governor. The high-pressure cylinder is equipped with expansion valve gear, and the low-pressure cylinder with simple slide valve. The principal dimensions of the engine are:

Diameter of high-pressure cylinder......	7.36 inches
Diameter of low-pressure cylinder.......	12.80 "
Common stroke	6.40 "
Revolutions per minute..................	350

The engine driving the dynamo for the electric light is a vertical, single-cylinder engine, directly coupled to the dynamo. This can also work non-condensing. It is controlled by a Stein patent crankshaft governor, and is equipped with a simple piston valve. The principal dimensions of the engine are:

Diameter of cylinder......................4.00 inches
Stroke ....4.48 "
Revolutions per minute.................... 500

THE BOILER PLANT.

The main boiler is a horizontal, cylindrical return-flame boiler of the marine type, with a heating surface of 2,231 square feet and 162 pounds per square inch working pressure.

The grate surface and the heating surface are of such dimensions that ample steam can be produced for all engines at the same time. For supplying steam for electric lighting, steam heating and for the bilge pump a vertical donkey boiler of 108 square feet heating surface and 103 pounds per square inch working pressure is provided. The guaranteed coal consumption of first-class coal of at least 13,500 B.T.U.'s per pound, while developing normal power is 2.1 pounds per hour.

POWER TRANSMISSION TO THE UPPER TUMBLER SHAFT.

The power of the main steam engine is transmitted to the upper tumbler shaft by means of a leathern belt and a double set of toothed gearing (helical wheels). Moreover, a hydraulic friction coupling is interposed, which enables the stopping of the bucket chain almost instantly, independently of the main engine. In order to prevent the chain with a full bucket from running back an efficient brake is provided.

WINCHES.

All winches for the maneuvering of the dredger while working are electrically driven independently from each other. The winches for the lateral movement of the dredger and those for hauling the barges are installed on the deck, as the drawing shows. All winches can turn in both a forward and backward direction, and are controlled by one man at the handles. The lateral winches are designed with horizontal drums. The motors driving the latter winches and the gearing are erected on the bed plates and situated under the deck.

The ladder is raised and let down by a winch erected at the fore-framing. *It is driven by a motor, well protected against the weather, and placed on deck.* The power of this motor is transmitted by means of spur and worm gearing to a wire drum.

On the fore-deck a capstan is fitted driven by the motor of the ladder-raising winch.

The *following electrically-driven winches* are provided: Two fore lateral winches, 2 after lateral winches, 1 winch for the fore hawser, 1 winch for the after hawser, 2 winches for hauling barges, 2 winches for the chutes, 1 capstan, 1 winch for the crane.

The winch for the sounding platform is driven by hand, and the windlass by steam. The lateral movement of the dredger is effected by means of chains, which are either guided through tubes at least 11 feet 6 inches below the water level, or run over guide rollers placed on deck. The forward and backward movement of the vessel is effected by means of steel wire hawsers. Also the bucket ladder is suspended by steel wire hawsers. On deck the necessary guide-rollers, hawse-pipes for guiding the chains and hawsers, and also hooring bitts, boat cranes, anchor cranes, and so on, are fitted.

HEATING AND LIGHTING.

The direct-connected dynamo engine supplies ample current for the necessary electric arc lamps and incandescent lights. Six arc lamps are provided for lighting on the deck, and for internal illumination incandescent lights are fitted.

The heating of the cabins, engineroom and winch hold is effected by steam, and in the crew quarters iron stoves are fitted.

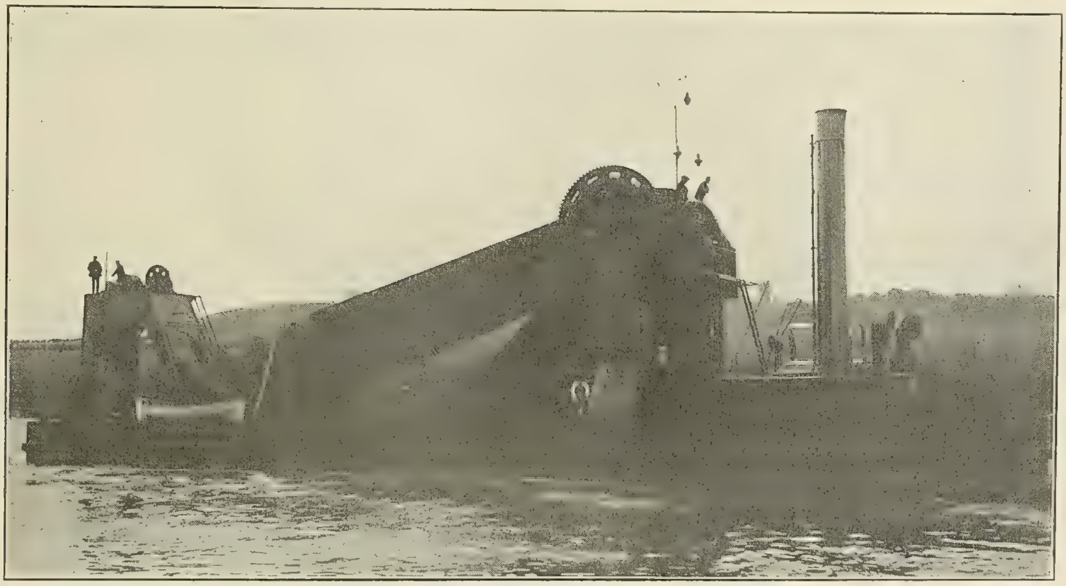


FIG. 1.—THE ROCK-LIFTING DREDGER VISCOUNT RIDLEY.

A ROCK-LIFTING DREDGER.

The deepening of the harbor and entrance channel at Blyth, so as to have 24 feet at low water or 39 feet at high water of spring tides, involves the removal of about 500,000 cubic yards of rock. For dredging this broken rock the Blyth Harbor Commissioners have recently introduced the powerful dredger *Viscount Ridley,* which has been built by Fleming & Ferguson, Ltd., of the Phœnix Works, Paisley. This vessel has a length of 136 feet, a breadth of 30 feet, and a depth molded of 11 feet 6 inches. She is specially constructed with heavy scantlings so as to withstand the abnormal strains of rock dredging, and is capable of lifting rock at depths varying down to 45 feet below water-line. The engines for driving the main gear are coupled direct to the gear shaft, and are supplied with steam from one large cylindrical return-tube boiler. The shaft for driving the bucket chain is driven through cast steel spur and bevel gear, the teeth all being machine cut. These, together with the shaft, brackets and framing, have a large

FIG. 2.—BOULDERS DREDGED FROM THE HARBOR.

margin of strength over the power developed by the engines, so that in the event of the buckets getting such a hold on the rock as to stop the gear, the risks of a breakdown are largely reduced.

The bucket ladder is constructed of mild H section girders, 96 feet in length between centers and 6 feet deep at center,

FIG. 3.—DREDGER AND HOPPER IN BLYTH HARBOR.

and is strongly braced, while the chain of buckets is of special design, the bucket rims being reinforced by hard steel cutting lips. Both the hull and machinery of the vessel were constructed under Lloyd's special survey, and the boat is fitted with a complete installation of auxiliary machinery. To maneuver the vessel, three specially powerful dredger winches are fitted on deck. Independent steam engines are provided

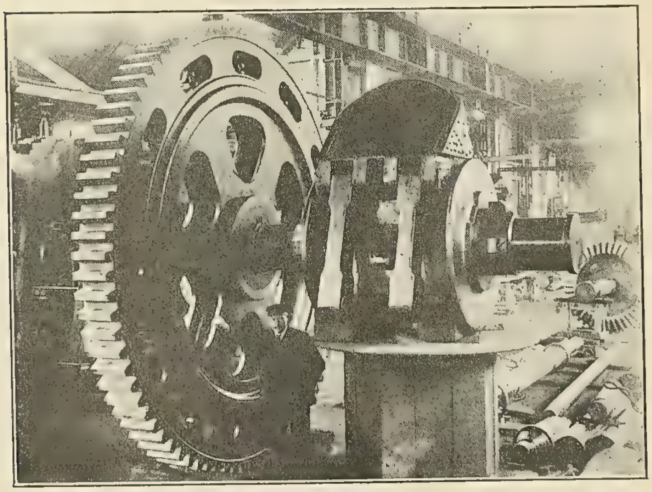


FIG. 4.—TOP TUMBLER AND MAIN DRIVING SPUR WHEEL.

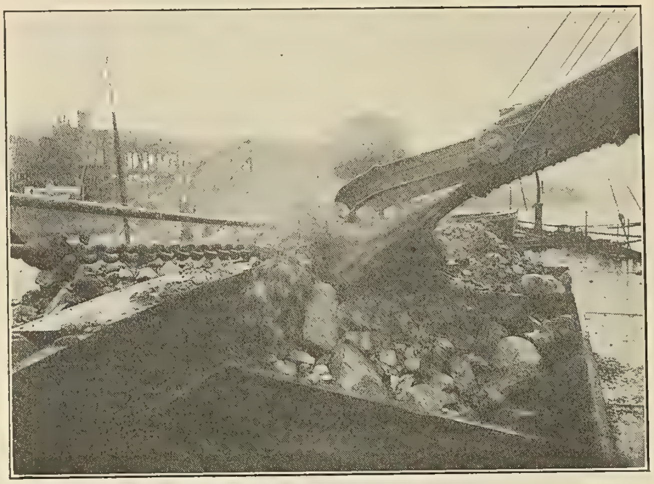


FIG. 5.—BOULDER COMING DOWN THE DREDGER CHUTE.

for hoisting and lowering the bucket ladder and shoots, and there is also an electric installation for lighting the vessel for night working.

The rock in Blyth harbor consists of very hard sandstone intermixed with veins of metamorphic rock, and large numbers of boulders are also met with. Fig. 2 shows a number of these boulders taken out of the buckets in the space of three hours. As the removal of the boulders from the buckets entails a loss of time, it was decided to allow them to go down the shoots into the hopper barge alongside, and to prevent them from damaging the barges strong channels are fixed to the points of the shoots in order to minimize the impact of the stones striking the hopper beams and chains of the barge. This arrangement has proved very successful, and stones weighing over a ton regularly pass down the shoots into the barges. Fig. 5 shows one of these boulders, which, owing to its shape, came down the shoots at a great velocity, and, striking the guard bar at the point of the shoot, traveled over the hopper on to the deck of the barge and then into the river. The guarantee undertaken by Fleming & Ferguson, Ltd., was to

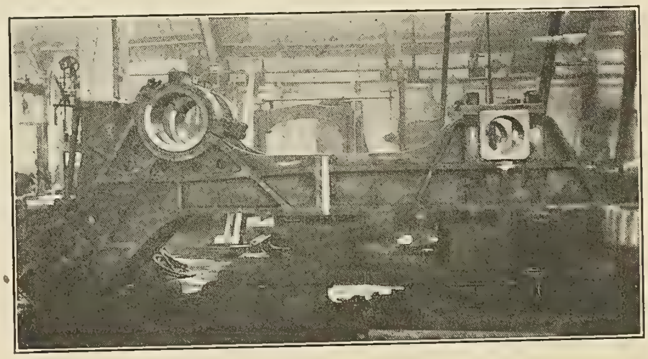


FIG. 6.—MAIN GEAR TOP BRACKETS.

raise 200 tons of rock per hour, and this was exceeded during the three days' consecutive trials just completed. The maximum rate of dredging obtained was at the rate of 273 tons per hour.

We are enabled to give a series of engravings and some drawings of this interesting vessel. Fig. 1 shows her leaving the builders' yard. Fig. 3 gives a view of the dredger with one of the hoppers lying alongside in Blyth harbor. Fig. 4 is reproduced from a photograph taken in the shops, and shows the top tumbler and shaft with a bucket and pair of links, and the main driving spur wheel; it gives an idea as to the proportions of the gear on this vessel. Fig. 6 shows the main gear top brackets in course of construction in the shops, and

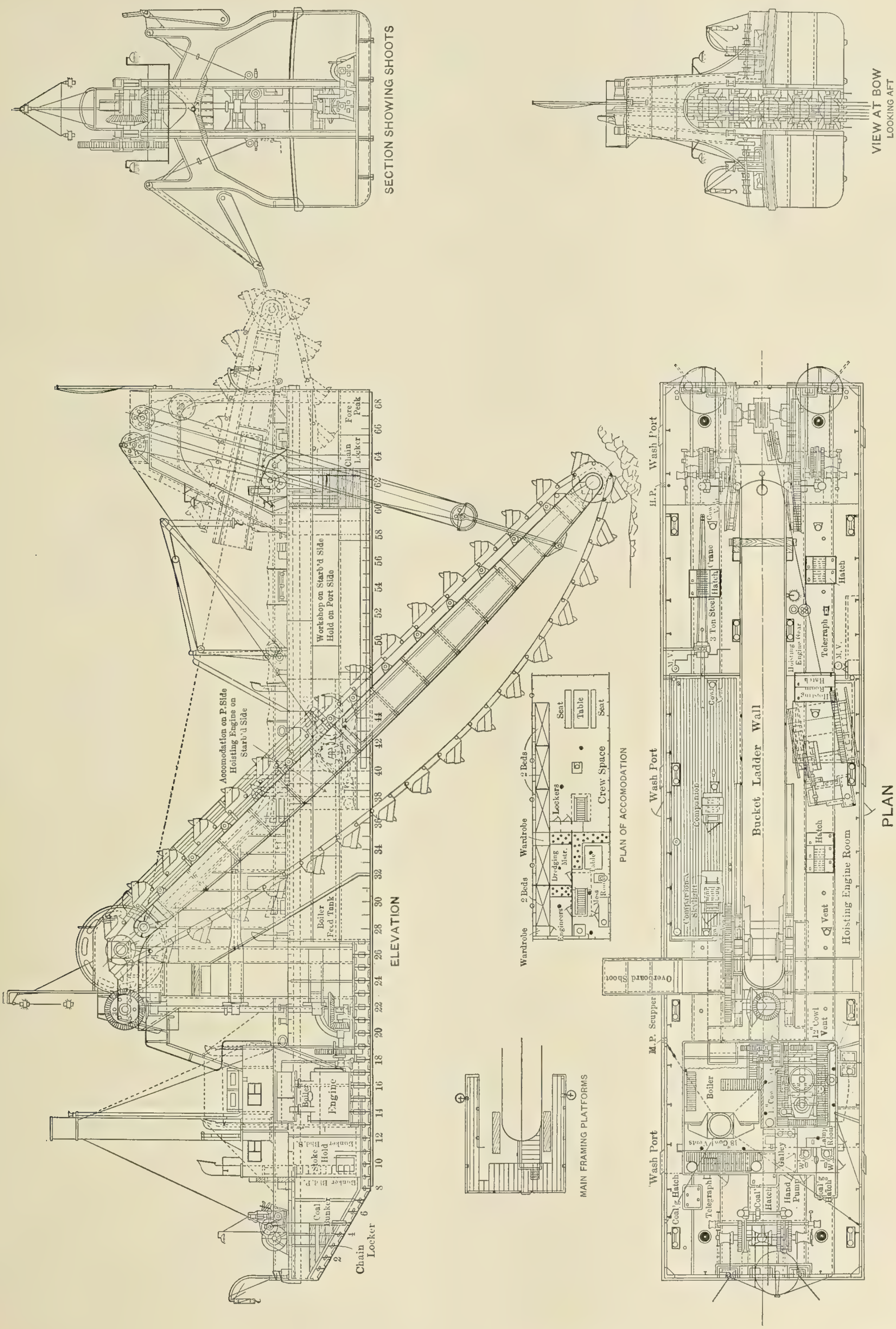


FIG. 7.—THE HOPPER DREDGER VISCOUNT RIDLEY

Fig. 7 gives detailed drawings. The vessel was built to the instructions and requirements of Messrs. J. Watt Sandeman & Son, Newcastle-upon-Tyne, the engineers for the Blyth Harbor Commissioners, and the trials were carried out under their supervision and that of Mr. G. D. McGlashan, the resident engineer at Blyth.—*The Engineer.*

AN ELECTRICALLY-OPERATED SUCTION DREDGER

BY WILLIAM T. DONNELLY.*

In Figs. 1 and 2 are shown designs for a new type of electrically-driven suction dredger which are the result of a recent thorough investigation of this problem, and which represent the most modern application of electricity to this work. The use of electricity in operating marine machinery of this class is not new. Perhaps the most notable example was the Bates electric-driven hydraulic dredger, previously illustrated and described in the May, 1909, issue of INTERNATIONAL MARINE ENGINEERING. A more recent example is illustrated in an article on "Electricity in Dredging on Puget Sound," published in the March, 1910, issue of *The Electric Journal,* which describes a smaller dredge operated by current supplied from a distant water-power generating plant. In both of these examples, however, the use of electricity was confined to the replacing of steam power in the operation of well-known types of dredging apparatus.

In the present study it is believed that a considerable advance has been made upon this practice in so modifying and designing the dredging apparatus as to take full advantage of the flexibility of electricity as a power device, and to thereby greatly simplify the installation as a whole.

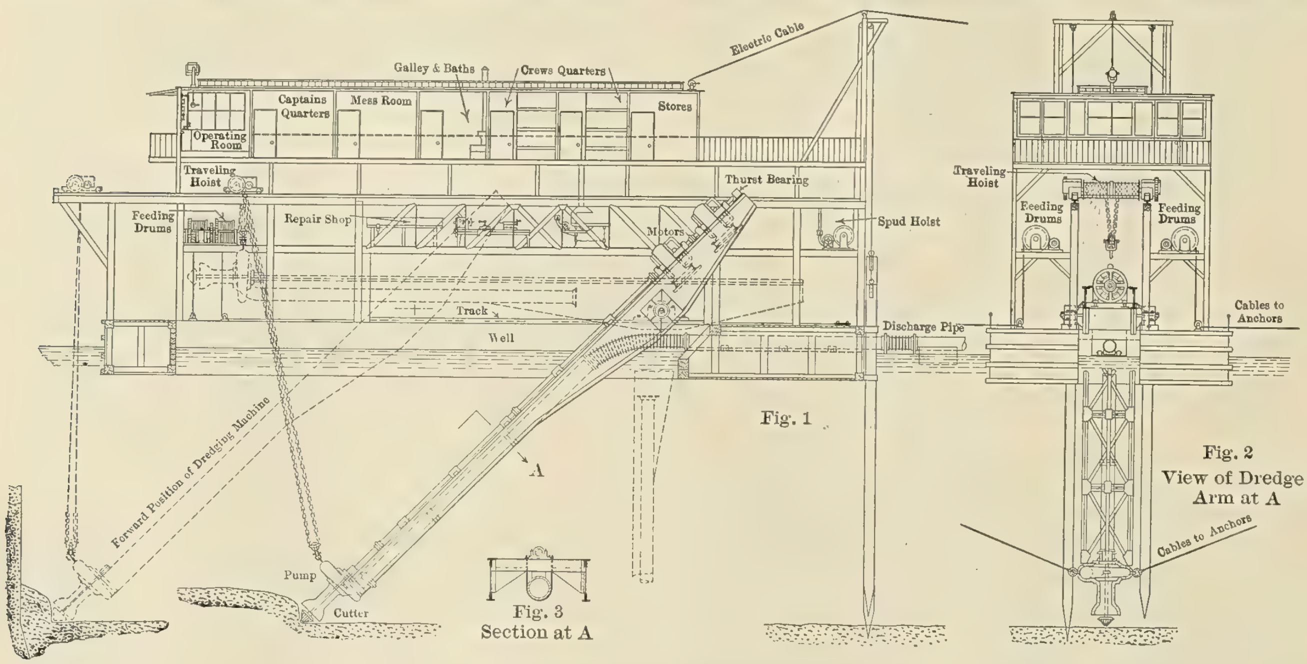
By referring to Fig. 1 and 2, it will be seen that the dredger scow or pontoon is of the usual rectangular construction of dimensions and displacement to correspond to the weight of apparatus which, in the electrically-operated dredge, will be of much less weight, owing to the absence of boilers, water and fuel. It will be understood that the design contemplates the operation of these dredges either from an outside source of electric current or from a floating central station of sufficient capacity to supply current to several dredges. The plans, as shown, are for a 20-inch suction dredge, which would require approximately 500 electric horsepower for operating through a discharge line of moderate length.

By referring to Fig. 1, it will be seen that the principal structural modification is to place the pump at the lower end of the ladder, thus making it submerged with a suction only a few feet long. A second modification consists in placing the cutter, which has heretofore been operated by a separate shaft and motor, upon the extended pump shaft. The much higher speed of the cutter makes it possible to decrease its diameter.

It will be seen that the ladder is extended beyond the fulcrum on the barge, and carries two electric motors mounted so as to act as a partial counter-balance for the weight of the pump and ladder, and that at the upper end of the ladder beyond the motors there is provided a powerful thrust bearing. The ladder and trunnions are made very heavy, the trunnions being 24 inches in diameter, of heavy ribbed steel casting mounted in large pedestals, which are secured on heavy cast steel plates or shoes extending along each side of the well.

An inspection of Fig. 2 shows that the suction ladder is raised and lowered by a standard electric crane, having a track running the entire length of the barge, with an overhang at the bow, making it possible to pick up heavy parts from a barge or other vessel at that point. By raising the ladder to a horizontal position, as shown by the dotted lines, and blocking underneath it, it is possible to use the electric crane for handling any part of the equipment for removal or repair. It is also possible, by proper arrangement of the bridle chain, to lift the entire ladder when in a lowered position, and by slacking off on the pillow blocks, move the ladder, pump and motors toward the bow of the pontoon, so as to enable the cutter to work up against a bulkhead or close to a pier.

It will be noticed that the delivery pipe runs below the ladder from the pump and through a gap at the stern of the dredge to the small pontoons, and that it is free to advance with the ladder when it is moved to the forward position in the pontoon. The design of the pump contemplates the division of the casing along the center line, with all bearings secured to the lower half so that when the ladder is lifted to the horizontal position and blocked up in place, the electric crane can



NEW TYPE OF SUCTION OPERATED BY ELECTRICITY.

* Consulting Engineer, 135 Broadway, New York City.

pick off the upper half of the casing, when access can be had to the interior for examination and quick repair.

From Fig. 2 it will be noticed that it is intended to operate the dredge by a lateral swinging motion, brought about by drift lines attached to the sides of the pump casing and running to anchors and back to a windlass operated by motor on board the dredge. The advance of the dredge will be accomplished by means of a pair of spuds in the usual manner.

Reference to the detailed sketch, Fig. 3, will show the manner of suspending the pipe line under the ladder. This makes it possible to readily remove sections of pipe when the ladder is raised.

The electric power equipment for the pump and cutter will consist of two motors operating on the same shaft, to be operated in series or parallel, as the length of suction pipe and the resulting power and speed may require. It will be seen that ample provision is made for crews' quarters and tools for prompt repair to small parts.

With the ever-increasing amount of suction dredging to be done, it is believed that the time has arrived to reduce the equipment of the suction dredge proper to the simplest practical construction, and to operate a number of them from one source of power, either from a floating generating plant specially designed for the economic production of power exclusively, or from an outside source of electric energy which can be depended upon for current at all times. The experience of all operators of dredging machinery is to the effect that profits are to be depended upon if the machinery can be kept constantly at work, and that failures and loss are occasioned by interruptions due to a breakdown in some part of the too complicated apparatus.

A careful review of the construction under this system shows that four dredges of this type with one power plant sufficient to supply power for all, would cost less than two complete dredges each having an entirely separate equipment of engines and boilers, and that they could be operated for less money. It should be further pointed out that the power-generating plant and the vessel containing it would be available for other purposes when not in use furnishing power to the dredges, while a dredge as such can be used for no other purpose when not engaged in dredging.

Figs. 4 and 5 are diagrammatic views, showing how a number of these dredges could be grouped to work to advantage; the plan view, Fig. 5, showing how they would be arranged for a wide channel, and Fig. 4, showing how they could proceed one after the other, deepening the channel.

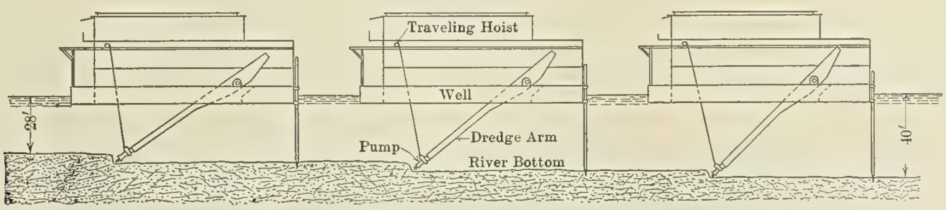


FIG. 4.—ARRANGEMENT OF DREDGES FOR DEEPENING A CHANNEL.

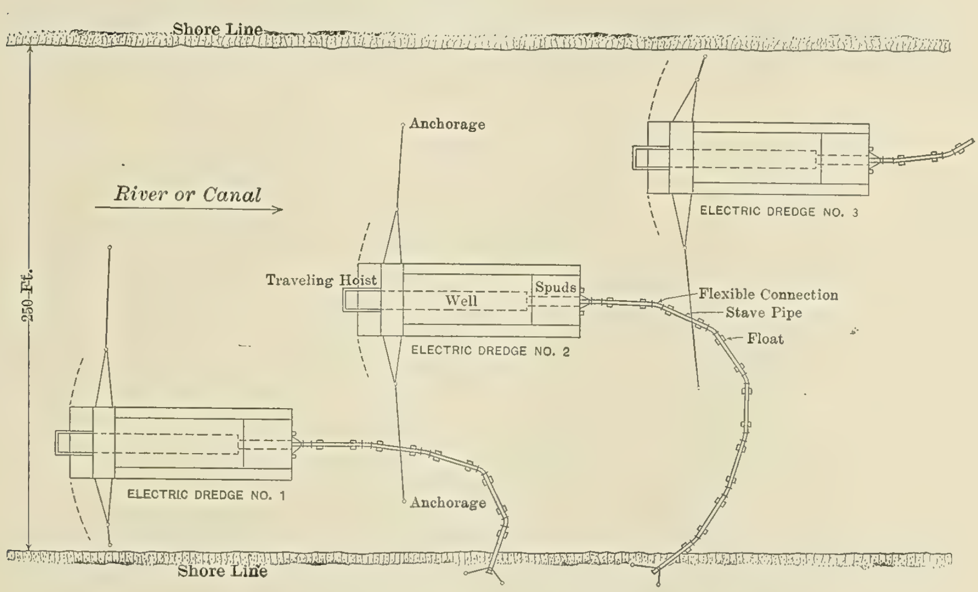


FIG. 5.—ARRANGEMENT OF DREDGES FOR WIDENING A CHANNEL.

This general system for the use of electricity is an outgrowth and extension of the writer's study of "Modern Marine Transportation," as published in the January and February, 1908, issues of International Marine Engineering.

Electric-driven suction dredges are being used with success on the Pacific Coast. In dredges of this type, built by the United Iron Works, Oakland, Cal., the electric current is supplied from an outside source, and is carried on board by means of a three-conductor cable, which is incased in 2-inch hose. The hose is put on in lengths of 50 feet, and has a special rubber jacket over each joint. The joint is thoroughly vulcanized, making it watertight. Where there is a sand bottom the cable is laid on the bottom of the channel; but where there is soft mud the cable often buries itself, and it is difficult to remove it, hence it is carried on a pontoon line.

MAMMOTH CLAY CUTTING SUCTION RECLAMATION DREDGERS.

A very powerful *clay* cutting suction discharging dredger, constructed in May, 1908, by Wm. Simons & Company, Ltd., Renfrew, Scotland, to the order of the Rangoon Port Trust, has been giving some remarkable results in service at Rangoon. This dredge, which is known as the *Pelican,* is one of the largest suction dredgers in the world. She is of the twin-screw type, 208 feet in length, 36 feet beam, with a draft of 10 feet 6 inches. The speed under ordinary conditions is 9 knots. The dredger is equipped with two sets of pumping engines, and is fitted with a suction pipe for dredging from a depth of 35 feet, and can deliver 80,000 cubic feet of sand and silt per hour through a pipe line 3,000 feet in length. There are special features in the design of the pipe line, which call for attention. The line is carried on a series of pontoons spaced 50 feet apart, center to center. The novelty in the pipe line is in the joint, employed between each pair of pontoons, to permit of lateral and vertical movement in the line of pipe. This joint is illustrated in Fig. 2. Formerly either rubber or leather jointing was employed for pipe lines of this character, but owing to the heavy nature of the service such joints had a very short life, and the necessity for frequent removal was constantly hanging up the plant. In the present instance, therefore, use has been made of a ball-and-socket joint of cast steel, the design adopted being claimed to give maximum freedom of movement in every direction while providing an absolutely watertight joint; special packing being employed for this purpose on the outer edge of the joint. This ball-and-socket design was first employed by Simons & Company, in a pipe line working at Calcutta, and the satisfactory behavior of the joint in service there led to its adoption for the pipe line now in service at Rangoon.

FIG. 1.—CLAY-CUTTING SUCTION DISCHARGING DREDGER PELICAN.

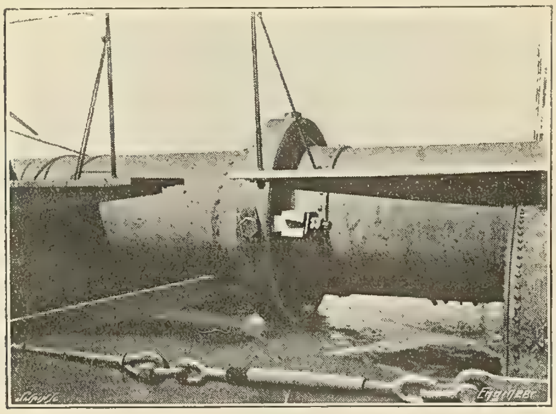


FIG. 2.—PIPE-LINE JOINT.

The main purpose for which the *Pelican* was specially designed and constructed was for the work in the Hastings Shoal, below Rangoon, the object being to deepen the main channel up to the port, so that the largest steamers might gain access to the wharves without discharging part of their cargo lower down the river, as has been necessary hitherto. This preliminary dredging work, now practically completed, will enable vessels drawing up to 28 feet of water to get up to Rangoon at all stages of the tide without unloading. The next work on which the dredger is to be employed will be in cutting through the Chalon Shoal above Rangoon.

PERFORMANCE OF THE JINGA AND KALU.

In our annual dredger issue for 1909 we gave a brief description of the reclamation dredgers *Jinga* and *Kalu,* built by Wm. Simons & Company, Ltd., for the Bombay Trust. These dredgers have now been in service over a year, and we are able to present a brief report of the work which they have done.

The total area to be reclaimed is 622 acres, of which 554 acres will be land actually retrieved from the sea, while the remainder is low-lying land, to be raised to a higher level. The reclamation will add about 6 percent to the area of Bombay, and by providing ground for the erection of depots for the seed, cotton and other trades will set free valuable residential building sites.

The *Jinga* began dredging late in the month of December, 1908, and the *Kalu* early in January, 1909. Since then both dredgers have been constantly employed in dredging and discharging stiff blue clay. A spiral rotary cutter of special form and of great strength is provided at the suction nozzle for breaking up the clay or other hard material. The pumping outfit of each dredger is claimed to be the largest and most powerful afloat, and consists of centrifugal pumps driven directly from triple expansion engines. The dredgers were each guaranteed to dredge 2,000 cubic yards of spoil per hour, and to discharge same to a distance of 4,500 feet through a floating pipe line. But in actual work the results obtained were greatly in excess of this guarantee. So far the best work done by either dredger is 2,700 cubic yards

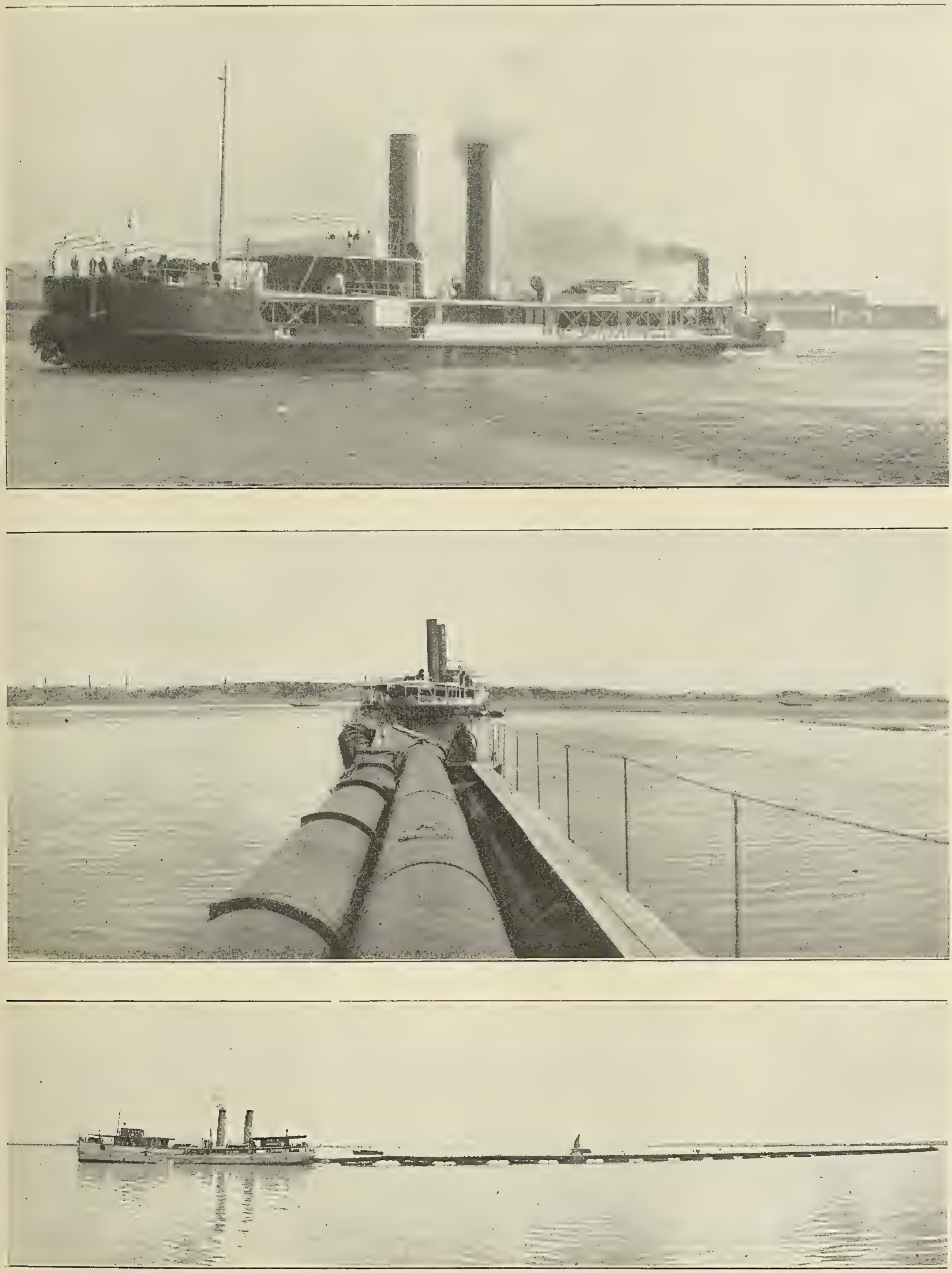


FIG. 3.—VIEWS OF SUCTION DISCHARGING DREDGERS AND PIPE LINES FOR THE BOMBAY TRUST.

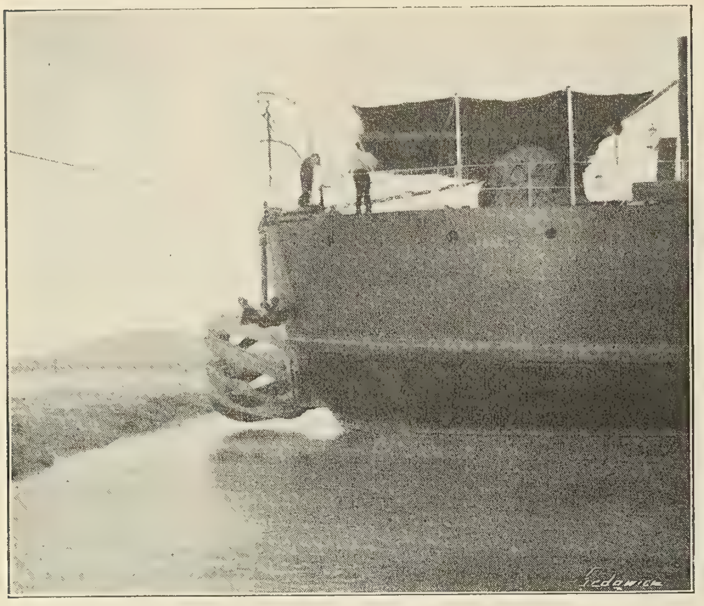


FIG. 4.—CUTTER.

per hour dredged and discharged; or in other words, results have been obtained which are 35 percent in excess of the guaranteed capacity.

The *Times* of India in instituting a comparison between the old-fashioned method of reclaiming by means of Coolie labor and bullock carts (when 5,000 bullock carts full per day was considered excellent work) says, "that the dredger will do nearly as much work per hour as the bullock carts will per day."

We reproduce a photograph showing the *Jinga* and a portion of its pipe line in a channel cut by the dredger itself. It may not be without interest to state that this dredger opened up a channel through land at some places above water level, 300 feet wide at water level by 30 feet deep by 3,000 feet in length in 250 hours' actual dredging time. Which is to say that the two dredgers working together could open a navigable channel equal in width and depth to the Suez Canal at a rate of 1 mile every 220 hours of actual dredging.

To illustrate the great volume of material discharged through the pipe line, photographs of the discharge at the end of the pipe line are shown in Fig. 5. Views are also shown of the dredger, and its line of floating discharge pipes and of the discharged material at end of pipe line.

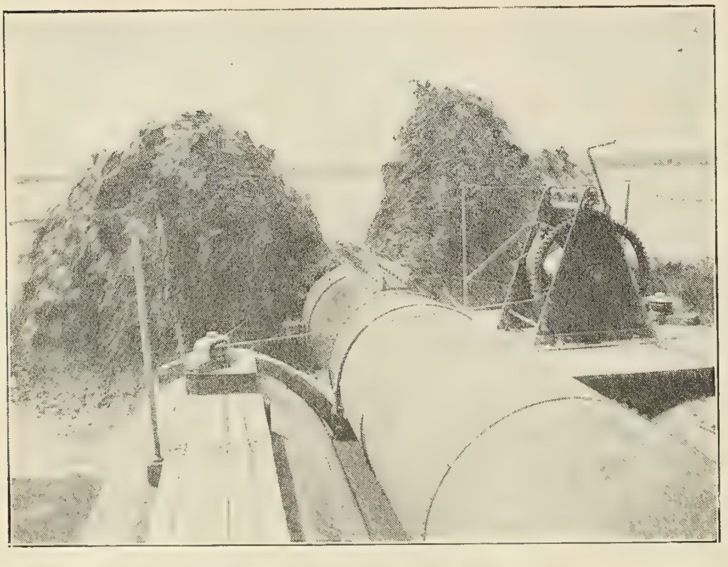


FIG. 5.—DISCHARGE AT THE END OF THE PIPE LINE.

On several occasions large pieces of stone and flint, weighing upwards of three quarters of a hundredweight, were discharged by the *Jinga* and *Kalu*. There is every reason to believe that many much larger and heavier stones were dealt with by the dredgers, but which, when discharged at the end of the pipe line, were covered up by the rush of clay, and thus could not be recovered readily. This belief is more than strengthened by the fact that one of the dredgers discharged a boulder which weighed more than 400 pounds.

LARGE CALIFORNIA GOLD DREDGES.

BY GEORGE BOWERS.

Some of the largest gold dredges ever put into operation in any part of the gold dredging world are installed on the Folsom Division of the Natomas Consolidated of California. These dredges are of two sizes, being equipped with bucket-lines of the close-connected type, the capacity of each bucket being 8½ cubic feet and 13½ cubic feet, respectively. The depth of the ground handled by these dredges ranges from 20 feet to 75 feet.

The ground being dredged is of two different kinds, and includes the well-known Rebel Hill. The gravel channel traversing this hill is deeper and more compact than any other in the district. It ranges in depth from 50 to 75 feet. and is virtually cemented for the first 6 or 8 feet, and is very compact for the next 25 or 30 feet, while the lower strata is loose.

To dredge this deposit, without constant blasting, was long considered economically impossible, and it was also believed impracticable to construct a dredge strong enough to dig this deep cemented gravel. However, the problem was successfully solved by Mr. R. G. Hanford, manager of the Folsom Development Company, and there are now three dredges having 8½ cubic feet buckets working successfully in this hard ground. These dredges work against a bank ranging from 20 to 27 feet high above the waterline, which is broken down by means of hydraulic monitors situated on the bow of the dredges.

The dredges working this ground were constructed by the Western Engineering & Construction Company, of San Francisco, Cal., and are equipped with machinery built by the Bucyrus Company, South Milwaukee, Wis. The latest of these is Folsom No. 6, which handles 165,000 cubic yards of gravel per month. The hull is 120 feet long, 46 feet 6 inches wide on the waterline, and 10 feet 3 inches deep, having 4-inch planking on the deck, sides and bottom; the stern planks are 8 inches thick, and the bow and well-hole planks are 6 inches thick. There are 86 buckets in the line, having a net capacity each of 9 cubic feet. The total weight of the line is 263,000 pounds. The ladder is of the plate-girder type. The revolving screen is 7 feet diameter by 36 feet long. The tailing stacker is of the lattice girder type, and is equipped with a 38-inch Robins belt conveyor, 142 feet centers. The steel spud is 34 inches by 54 inches by 75 feet long, and weighs 76,000 pounds. The wood spud is 34 inches by 54 inches by 76 feet long, and is one of the largest single sticks of timber ever handled on the Pacific Coast.

The gold-saving tables are of the double bank type, and are constructed of steel, and have 3,000 square feet of riffle area. The upper tail sluices extend approximately 38 feet behind the stern of the dredge. The lower tail sluices extend approximately 20 feet behind the stern of the dredge.

The double bank of tables has accomplished two vital objects: First, materially increasing the gold-saving area, and, second, by the use of four tail sluices of different lengths the sand and fine gravel is more evenly distributed behind the

dredge, thereby making it possible to discard the use of a sand pump, which has always been a source of trouble and expense.

The high-pressure water used inside the revolving screen for disintegrating the material is supplied by one 12-inch centrifugal pump, direct connected to a 100-horsepower motor. The water supply for the tables is supplied by a 12-inch centrifugal pump, direct connected to a 50-horsepower motor, and the dump hopper sprays, for washing the buckets, are supplied by a two-step centrifugal pump, direct connected to a 30-horsepower motor.

There are two hydraulic monitors, fitted with 3-inch nozzles, which are located on the port and starboard bows of the dredge. These monitors are supplied by one 12-inch centrifugal pump, direct connected to two 150-horsepower motors, delivering water against a head of 150 feet, and can be operated either together or separately.

The aggregate capacity of all motors installed on the dredge is 790 horsepower. The total weight of the machinery, including hull complete, is 2,395,235 pounds.

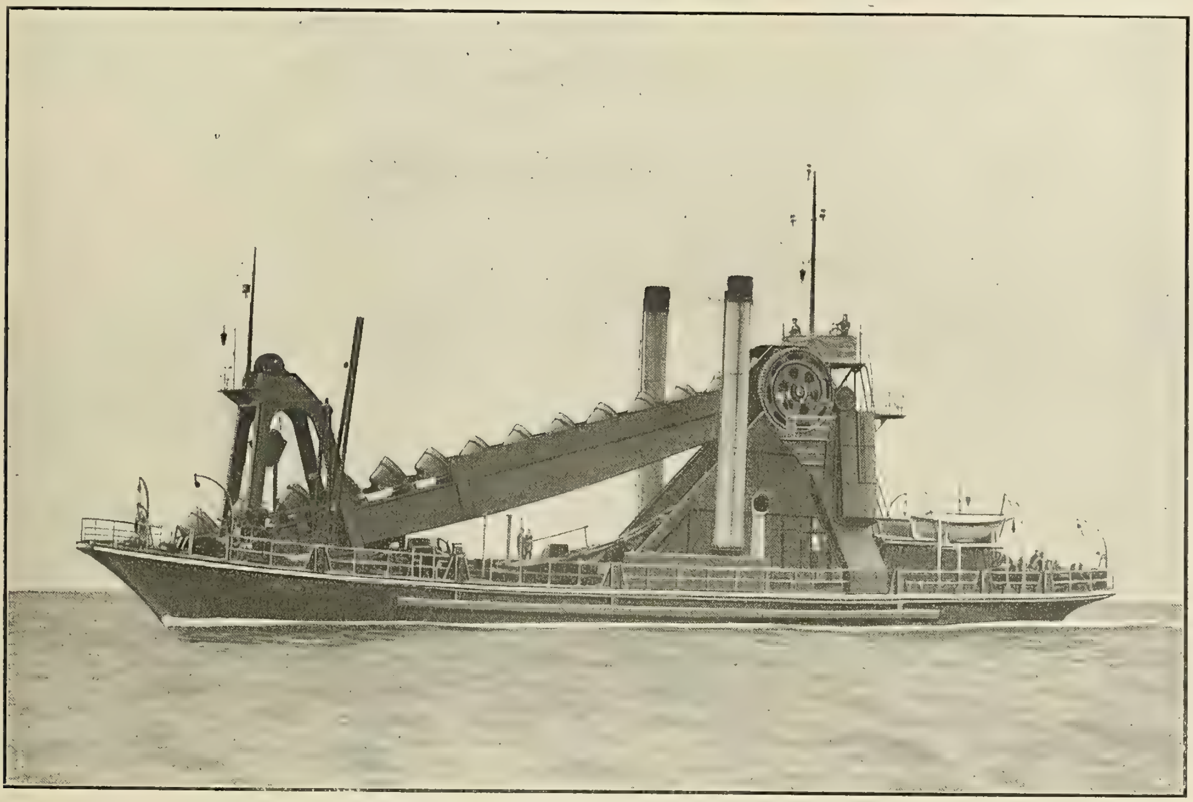
The successful operation of Folsom No. 6 demonstrated clearly that it was not impossible to dredge the compact gravel on Rebel Hill with large machines. The Natomas Consolidated, of California, is now building a 13½-cubic foot bucket dredge to handle this deep ground, which will average from 60 to 65 feet below waterline. The dredge will be placed in commission during the present year.

The 13½-foot bucket dredges now in operation upon this property are working in loose and sandy ground. They are equipped with extra large shaking screens, double-bank type of gold-saving tables, and dig 20 feet below the water level. Each dredge has a capacity of 250,000 cubic yards per month. The aggregate horsepower of all motors on the dredge is 605. The problem of clearing the dredged area, covered with great piles of dredge tailing, ranging from 30 to 45 feet high, and returning the ground to a farmable condition, has been successfully solved.

A LARGE BUCKET DREDGER.

The illustration shows the self-propelling barge-loading bucket dredger *Crewe* for the London & North Western Railway Company for service at Garston Dock, Liverpool, by Ferguson Bros., Port Glasgow. The dredger, which was launched complete with machinery aboard and steam up, is the largest and most powerful bucket dredger owned by the company. She is of the bow-well, center-bucket ladder type, and is capable of raising 900 tons per hour.

The vessel is built to Lloyd's highest class; side shoots are arranged for discharging the dredged material over either side into hopper barges, the lifting and lowering of each shoot being worked by an independent steam engine. The main engines, which are employed for either propelling or driving the dredging gear, consist of one set of triple-expansion surface condensing engines of 700 horsepower. There are two speeds of gearing to enable the buckets to be worked at different speeds, according to the nature of material being dredged. Two large multi-tubular boilers supply steam to the various engines. The lifting and lowering of the bucket frame is controlled by an independent double-cylinder engine, working the latest improved type of hoisting gear. The accommodation for the officers and crew is fitted forward, and is commodious and handsomely finished. Electric light is fitted throughout.



SELF-PROPELLING, BARGE-LOADING BUCKET DREDGER CREWE.

When the launch of the cruiser Minnesota was lost in Hampton Roads with several midshipmen on board a year or more ago, the fatality was attributed to the fact that the canvas covering used on the metal frame work as protection against the weather was so fastened that it could not be quickly released, and the men were thus hopeless imprisoned in the sinking boat. This fact has led the naval constructors to work out a design for a launch canopy which can be easily adjusted and folded out of the way in case of danger.

GOLD DREDGING IN CALIFORNIA.

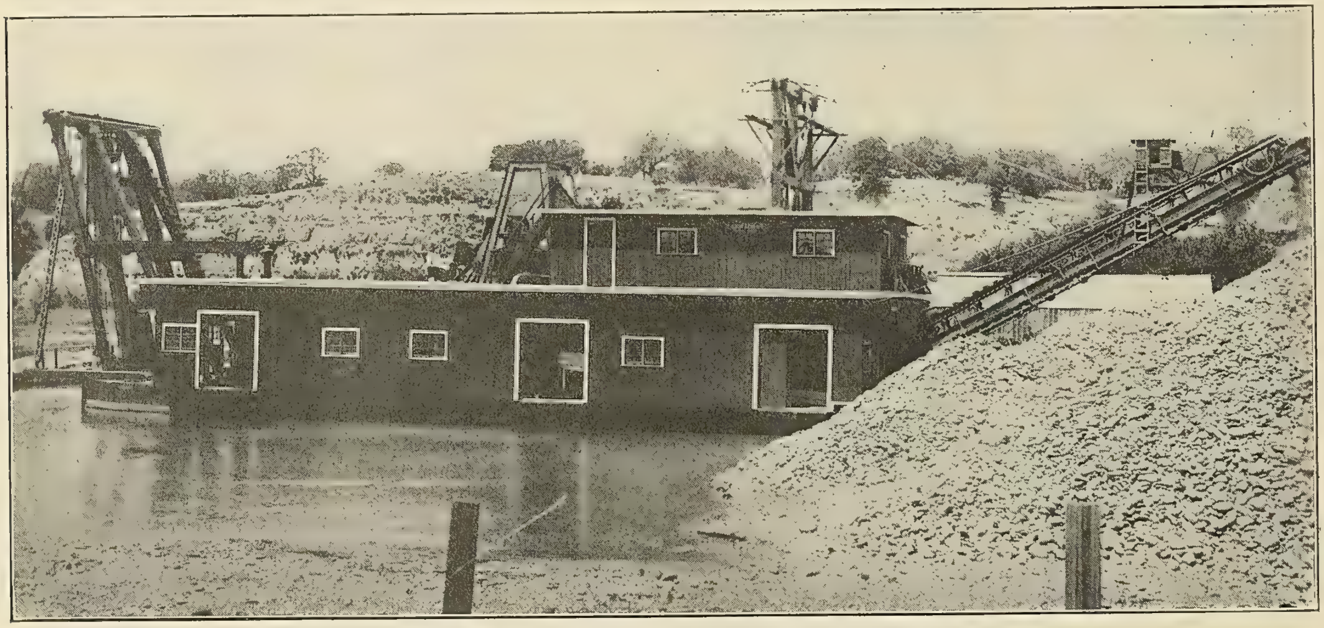
The first successful gold dredge put in operation in this country was in 1897, by the Risdon Iron Works, of San Francisco. This dredge was practically a New Zealand machine (in which country the gold dredging industry had been growing steadily for the previous ten years). Since the date of the first successful gold dredge in this country the growth of the industry has been very rapid. It is safe to say, in California, there are over seventy machines in operation, and the annual returns in gold are between seven and eight million dollars.

The first machine to be installed was one having buckets of 3¼ cubic feet capacity, with a monthly capacity of between 35,000 and 40,000 cubic yards. The size of machine and capacity have steadily increased until the buckets have a capacity of 13 cubic feet, and the monthly yardarge will exceed the 250,000-yard mark.

While the machines themselves have been greatly improved in size, strength and design, at the same time the very latest up-to-date machine of to-day combines and utilizes exactly the same principle of the first successful machine in 1897. The machine consists of a pontoon provided with a long well for a little over half of its length, in which well is lowered a steel ladder, hinged at the upper end. This ladder carries the chain of digging buckets. The buckets discharge the gravel into a revolving screen, which screen separates the fine material and gold from the coarse. To aid the separation, water at a high pressure is discharged from a pipe in the revolving screen on to the material, and the high efficency of this simple device is remarkable. While it will not save all the gold, at the same time it is safe to assume that 95 percent of the gold is saved when this method of procedure is followed. The perforations in the revolving screen average ⅜ inch in diameter, and nothing over that size passes onto the tables. The balance of the material is carried away by means of a stacker and stacked at the stern of the dredge. Necessary winches and driving mechanism, of course, together with pumps, make up the complete machine.

With the growth of this industry a great number of experiments have been tried, but, whenever the experimenters have departed from the principle of this machine, they have not met success or only partial success. Of course, the general design of the machines has been greatly improved and simplified. Manganese steel has been introduced for all tumbler plates, bucket links, bucket lips, screen plates, etc., and, in fact, all parts subject to wear are now made of this material, the cost of which is about twice that of the other, but the wearing value is easily five or six times greater than the cheaper material.

With the introduction of the very large machines, ground that only contained gold values between 6 and 7 cents per cubic yard, and was hitherto considered worthless, is now being successfully handled and large profits made with the new large modern machines.



7-CUBIC-FOOT RISDON GOLD DREDGE, CAPABLE OF HANDLING 85,000 CUBIC YARDS PER MONTH.

PORTABLE DREDGES.

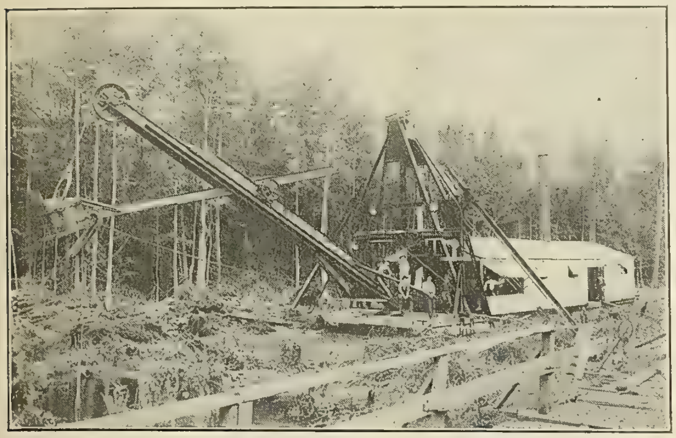
Dipper dredges might, for discussion, be divided into two distinct classes with reference to the conditions under which they are designed to work, viz.: those of a permanent nature employed in river or harbor work, and which are towed from place to place, and where it is necessary to use vertical or upright spuds; and those which are more of a portable nature, permitting of being dismantled and transported from job to job, and which are used in the construction of drainage ditches and canals, where the banks of the channel are available for anchorage, and where what are termed bank spuds are employed.

This latter type, owing to the wonderful impetus to the reclamation of swamp lands in the last few years by systematic drainage, has been developed to a high degree of efficiency. We illustrate herewith a modern dredge of this type known as the American steel dredge, manufactured by the American Steel Dredge Company, of Fort Wayne, Ind.

In this dredge the superstructure, including the boom, "A" frame, dipper handle, spud frame and spuds are constructed of steel, only standard commercial shapes being employed, with the result that the maximum stiffness and rigidity are combined with the minimum of weight, and the ability of being conveniently dismantled and transported from one place to another. This feature is further exemplified by the hull being constructed in sections on entirely new lines with the same purpose in view.

The dipper is operated by a single line of cable running

direct to the hoisting drum, over but one sheave of large diameter at the point of the boom, thus reducing internal friction, offering conditions for the longest life of the cable and smooth and noiseless operation, aside from increased reach. This arrangement of the cable is accomplished by the unique design of compound-geared hoisting engines, all gearing for



PORTABLE DREDGER WORKING IN SWAMP LAND.

which, together with that of the independent reversible swinging engines, is of steel with machine-cut teeth.

The bank spuds are automatic in their action, being positively and automatically locked in any position, and it is claimed are exceptionally quick and effective in their operation.

These dredges are distinctive by having no welds, rods or turn-buckles in their construction. They are built in a number of sizes up to 2½ yards.

Comparative Cost of Operation of Cruising Launches of the Revenue Cutter Service Using Coal and Gasoline (Petrol).

The revenue launch *Guard* is a single-screw wooden launch of 30 tons displacement, being 65 feet long, 9 feet 6 inches beam and 5 feet 3 inches depth, fitted with a compound engine with cylinders 7 inches and 15 inches diameter and 10 inches stroke, and is stationed on Puget Sound, Washington. The revenue launch *Guide* is a twin-screw wooden launch of 32 tons displacement, being 70 feet long, 13 feet beam and 7 feet 11 inches depth, fitted with two 60-horsepower Standard gasoline marine motors, and is stationed at New York City. During the fiscal year ended June 30, 1909, the *Guard* cruised 6,041.5 miles, using coal as fuel, and consumed for this distance 119.4 tons, which cost at an average of $6.53 per ton, $779.68, or, the cost of cruising one mile was 12.9 cents. During this same period the *Guide* cruised 6,548 miles, using gasoline, and consumed for this distance 9,483 gallons, which cost, at 11 cents per gallon, $1,043.13, or the cost of cruising one mile was 15.9 cents. Therefore, from these two launches, with coal and gasoline at the prices noted above, coal shows an advantage over gasoline of 18.9 percent.

But in New York City for the fiscal year ended June 30, 1909, coal was furnished, under contract, for $2.95 per ton. If the *Guard* had been stationed there, the cost of the coal for the year would have been $352.23 to have cruised the same distance as on Puget Sound, which is at the rate of 5.83 cents per mile, and to have cruised the same distance that the *Guide* did, namely, 6,548 miles, the cost would have been $381.75, as against the $1,041.13 that the *Guide* expended for gasoline, or a gain of 63.3 percent; while if the *Guide* had been stationed on Puget Sound, where gasoline costs 16 cents a gallon in Seattle, it would have cost for the 6,548 miles cruised, $1,517.28, as against $844.69, which the *Guard* would have expended in cruising the same distance on coal at $6.53 per ton.

Shipbuilding Reports.

The Bureau of Navigation reports that 74 sailing and steam vessels of 15,275 gross tons were built in the United States and officially numbered during the month of January, 1910. Of these 38 vessels, aggregating 3,832 tons, were built on the Atlantic and Gulf coasts, and 26 vessels, aggregating 11,276 gross tons, on the Great Lakes. The steel steamship tonnage on the Atlantic coast amounted to only 1,386 tons.

For the month of February, 1910, the Bureau of Navigation reports that 57 sailing and steam vessels of 11,663 gross tons were built in the United States and officially numbered. Of these 22 vessels of 5,607 gross tons were built on the Atlantic and Gulf coasts and 11 vessels of 4,449 gross tons on the Great Lakes. Only one steel steamship of 4,015 gross tons was built on the Atlantic coast during this month.

The report of the Bureau of Navigation concerning the number and tonnage of vessels built in the United States during March, 1910, is very encouraging. The steel tonnage built and numbered during this month exceeds that built and numbered in any corresponding period. One hundred and thirteen sail and steam vessels of 78,257 gross tons are enumerated in the report. Of these, 50 vessels of 20,274 gross tons were built on the Atlantic and Gulf coasts and 14 vessels of 56,831 gross tons on the Great Lakes. The construction of steel steamships on the Atlantic and Gulf coasts comprised 6 vessels of 17,536 gross tons.

Shipbuilding reports for the nine months ending March 31, 1910, show a considerable increase over the corresponding period ending March 31, 1909. According to reports of the Bureau of Navigation, 806 sail and steam vessels of 187,620 gross tons were built in the United States and officially numbered during this period, while for the corresponding period in 1909 only 696 sail and steam vessels of 80,332 gross tons were built. Of the total, 388 vessels, aggregating 82,652 gross tons, were built on the Atlantic and Gulf coasts, 164 vessels of 6,258 gross tons on the Pacific coast, and 138 vessels, aggregating 95,584 gross tons, on the Great Lakes. Thirty-one steel steamships of a total of 58,342 gross tons were built on the Atlantic coast.

Lloyd's Register Shipbuilding Returns.

According to Lloyd's reports there were 386 vessels of 1,057,636 gross tons under construction in the United Kingdom at the close of the quarter ending March 31, 1910. Of this amount 341 vessels of 1,051,667 gross tons are steel steamships. For the corresponding quarter of 1909 there were under construction in the United Kingdom 399 vessels, aggregating 912,272 gross tons, of which 337 vessels of 902,979 gross tons were steel steamships.

The tonnage now under construction is about 144,000 tons more than that which was in hand at the end of the last quarter, and also exceeds by about the same amount the total building twelve months ago.

The figures for warship tonnage now being built (303,685 tons displacement) are the largest reported since September, 1904.

The 29.5-knot destroyer *Perkins* was launched at the yards of the Fore River Shipbuilding Company April 9. The *Perkins* is 293 feet 10½ inches long over all, 26 feet 4½ inches molded beam, and with a draft of 8 feet 4 inches displaces 742 tons. The machinery consists of Fore River-Yarrow water-tube boilers, supplying steam for two Curtis reversible marine turbines 6 feet in diameter, and capable of developing 6,000 horsepower each at about 600 revolutions per minute.

THE MARINE STEAM ENGINE INDICATOR — X.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

REDUCING MOTIONS (CONTINUED).

Fig. 76 shows an arrangement, by means of which the movement of gears like that shown in Fig. 61 is corrected. This is another case of similar triangles. The ratio of reduction is $\left(\frac{x}{x+y}.\right)$ A telescopic reducing motion is shown in Fig. 77. It consists of a steel rod working in composition tubes. The velocity ratio is constant and equal to $\frac{x}{x+y}$ as before.

It will be noticed that in all of the gears shown—those which give a correct reduction—the reciprocating motion is transmitted to and taken from the lever by mechanisms of the same kind, the parts being geometrically similar and proportional. With this simple idea in mind, it will be easy to design other forms of correct reducing motions in addition to

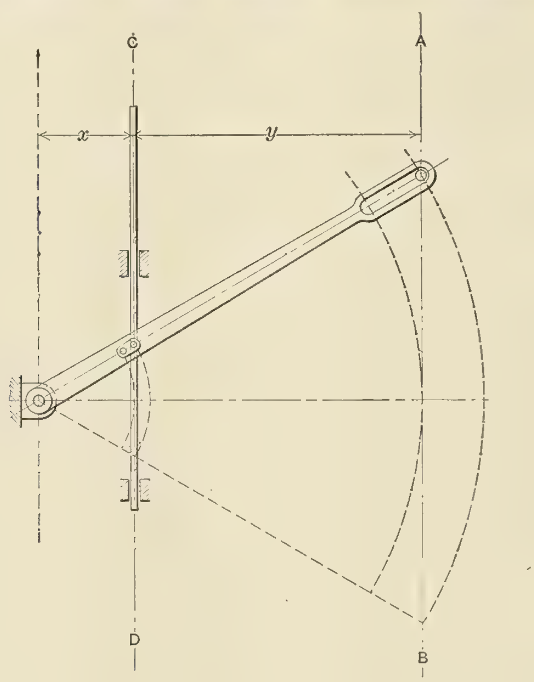


FIG. 76.

those shown above. For instance, suppose it were desirable to make a gear like that in Fig. 62, to give an exact reduction. It would only be necessary to fit a guide rod—parallel to *A B*—provided with a slotted cross-head like that at 7-4 to engage the pin at *D*. The gear shown in Figs. 54 and 55 (March issue) could be corrected in the same way.

As an assistance in getting the proper relation between the guide rod axis and the center line of the indicator cocks, consider the diagram Fig. 78, which shows roughly the top view of an indicator connected to a vertical engine. *A* is the center of the indicator cock; *B* the center of the paper drum; *C* the cord center with the guide-pulley arm in its most extended position, and *C′* the cord center with the guide pulley arm folded against the steam cylinder of the instrument. With a radius *A C′*, draw the small arc *C′ D E*, with *A* as a center. About the same center and with a radius *A C*, describe the arc *C F G*. Draw *E G* at an angle of 45 degrees with the line *F H*, the line intersects the center of the engine cylinder and indicator cock. The guide rod center line may be located at any point within the area *C′ C F G*, provided that a proper

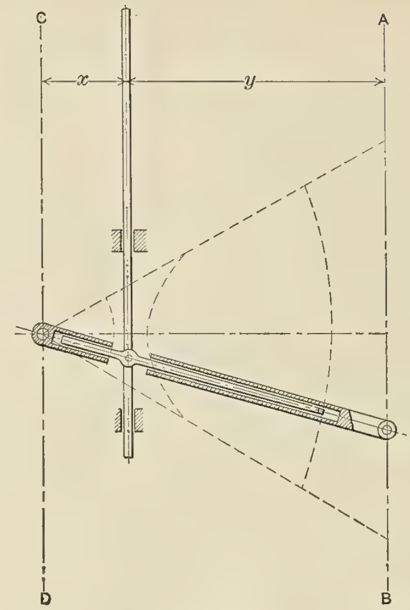


FIG. 77.

amount of room is left for the operation of the pencil-motion swivel head. This can be determined by sketching the indicator on tracing cloth and rotating the sketch on the drawing.

The main lever of the reducing motion may be offset horizontally, if necessary, to bring the guide rod in line, or the guide-rod gear may be driven by a fore-and-aft shaft in the manner often used for revolution counters, but care must be taken to preserve the constant velocity ratio, which is essential to correct reduction. If, however, it is impossible to properly locate the guide rod, fair-leaders or carrying pulleys must be used. The pulley next to the reducing motion must be so located that the cord will lead off parallel or coincident with the center line of the guide rod. If this is not done, all the time and care expended on the reducing motion is wasted. A glance at Fig. 79, which shows an exaggerated case of non-alignment, will show the reader the importance of the loca-

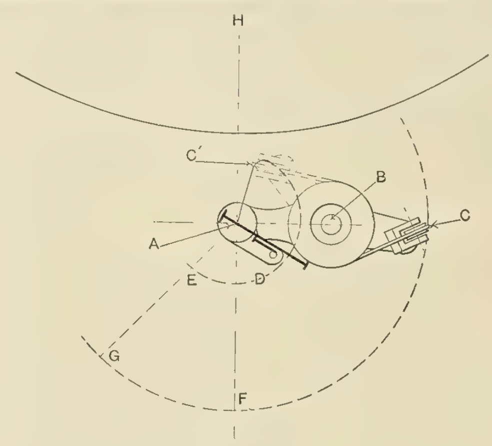


FIG. 78.

tion of this pulley. After the cord has passed this first fair-leader, it may be led in any convenient direction to the guide pulley of the indicator.

To complete this section, but two other forms of reducing motions will be noticed, and while they are not often used on shipboard they may be found convenient in certain situations. Fig. 80 shows a gear fitted to a shaft end, consisting of a crankpin and connecting rod. It gives a correct reduction when the ratio of *A* to *B* is the same as the ratio between the engine crank and connecting rod, and when the angle between *C* and the engine crank-pin center is 0 degrees.

Fig. 81 shows a "lazy tongs" system of levers. This is a pantograph without alterations or substitutions of any kind. The "hitch strip" G is so made that it may be shifted in the holes at E E, so as to bring the "hitch pole" F in a line passing through the joints C and D. C is connected to the cross-head, and D to a stationary support. F and G are shifted

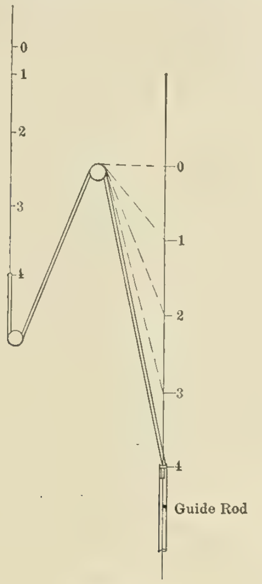


FIG. 79.

to get the proper velocity ratio, and to bring F in line with C and D. The cord is led off from F, so that it will be parallel with the line of stroke. With this arrangement the apparatus gives a correct reduction.

Finally, no matter what form of reducing motion is fitted, it should be kept in good condition. Racks should be bolted to

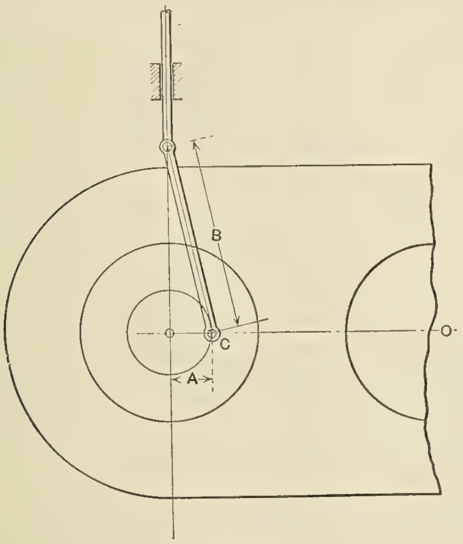


FIG. 80.

one of the bulkheads in a convenient location, and when the gear is not to be used during the next passage, the main lever and its links should be disconnected and stowed in the racks. The mechanism is thus kept in good order and the annoying rattle of a slack gear avoided.

(*To be Continued.*)

The United States battleship *Florida* will be launched May 12 from the Brooklyn navy yard. Her sister ship, the *Utah*, was launched at the works of the New York Shipbuilding Company last February.

FUEL OIL—II.

BY E. N. PERCY.

The physical characteristics of fuel oil, so far as the power engineer is concerned, are, briefly, as follows:

In color fuel oils vary from brown to black. Very light brown, or light green, indicate, roughly, a light oil, full of gas. This should be handled carefully, is characteristic of light, unrefined oils, distillates and paraffin base oils. Heavy brown and black oils are asphaltum base, and are lighter when this is removed. The fluorescence of all oils is green, but changes to blue in the kerosenes and light lubricating oils. Asphaltum base oils, if boiled away, will, roughly speaking, leave an asphaltum residue, while paraffin oils will leave paraffin, vaseline, etc., as a residue.

The specific gravity varies from 1.025 to 0.749, and is always stated in terms of Baumé scale. Market fuel oil ranges from

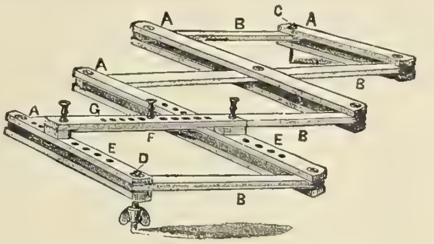


FIG. 81.

13 to 16 degrees Baumé. The gravity is the most important method of classifying fuel oils, but it must not be confused with viscosity or stiffness. A very stiff oil that will not flow without heating may be of light gravity, or a very watery, light-flowing oil may be very heavy in gravity. Oils are rated in gravity at 60 degrees temperature Fahrenheit, and heating them lightens their gravity from 2 to 3 degrees Baumé for every 100 degrees temperature Fahrenheit.

The specific heat of petroleum is, in general, 0.511.

The latent heat of vaporization is variable, but averages one-ninth that of water.

Detecting the odor is an important method of inspection, but must be learned by experience. Some wells furnish oil with very objectionable odor, some refineries furnish a fuel oil with the same characteristic. Others smell sweet. While little can be told of the ingredients by the odor, it is easily possible for an experienced man to know where the oil comes from by the color and odor. Any large quantity of sulphur can be immediately detected by the odor; but the engineer cares very little about this constituent one way or the other. It is said that it forms sulphurous acid, which attacks the iron of the boilers, but observing engineers do not bear out this theory.

The viscosity ranges from heavy semi-solid oils that have to be heated to be handled to less than 1.00, which is the viscosity of water. These very heavy thick oils are gradually being used for other purposes, such as road making, or distilled for asphaltum and paint, and fuel oils are becoming lighter and more uniformly classified. An average viscosity would be 1,000 for 14 gravity, 400 for 16 gravity, 75 for 18 gravity, and 15 for 20 gravity. Oils of 20 degrees gravity flow easily under moderate head, 18 may be piped readily, but heavier than this requires a good pressure or heating, or both. The viscosity is measured by the number of seconds it takes a measured amount of fluid to flow from an orifice, water being one. Viscosity falls very much more rapidly than the gravity when the oil is warmed up, and an increase from 60 to 110 degrees F. with an average fuel oil of, say, 16 gravity and 300 viscosity will reduce the viscosity to 30 or 40; in other words, it will be ten times as thin as before, and can be pumped with perfect ease. Average fuel oil, warmed up to 100 degrees F., will require 50 percent more power to pump than water

under exactly the same conditions; but a slight difference of conditions will change this proportion greatly.

The flash point, or the temperature at which oil will ignite, is another important characteristic usually embodied in specifications, especially for protection against fire and explosion. It is the point at which oil gives off vapor at a temperature that will flash or ignite. It ranges from 60 to 400 degrees F. Zero is obviously too low, as most fire-rooms will run to 150 degrees temperature at times, and this heat, communicated to the tanks, would keep them covered with inflammable gas at all times. On the other hand, if the flash point is too high, it in itself is of no harm, but indicates a heavy oil, with little or no light constituents. The accepted flash point for marine work is not less than 150 degrees, but it is probable that a somewhat higher figure would be better, as this admits many crude oils, on a pinch, that really have some light parts that vaporize in a warm tank. One ship that was blown all to pieces in San Francisco Bay was afterwards found to have had 85 gravity oil in one of her tanks. The tanks were all nominally empty, and were being overhauled; but it is probable that they were filled with certain light vapors mixed with air.

The calorific value averages 18,000 British thermal units for all kinds of fuel oil, and in comparison with coal, the following factors, established by practice, should be considered: First, the calorific value of the coal in question, which varies from 7,000 to 14,000 British thermal units; second, the heating efficiency of the oil fire as compared to the coal fire, which happens to be slightly in favor of oil, but the evaporating capacity is greater, that is, oil will evaporate 4.5 pounds of water per hour per square foot of heating surface and at 80 percent efficiency. This may be hard on the boiler, but that has not yet been proved.

Impurities in fuel oil, if crude from the well, consist of sand, mud, lumps of asphaltum, gravel, light oils, clots of heavy oils and sulphur; all of this is supposed to be removed by responsible sellers of petroleum and is, in addition, provided for in the specifications of all large users of fuel oil, such as steamship companies.

Fuel oil is not harmful to metals, pipes or brick. It is harmful to rubber, fabrics, concrete, paint, bright work and fine working parts that might gum up.

The vapors and gas from petroleum are liable to asphyxiate if confined; hence one should never go into a tank or riser unattended, never with a naked light.

Petroleum rapidly becomes thick and asphalty by standing in the sunlight, and any fuel oil that has been long in the sun should be looked upon suspiciously as being pretty heavy and liable to give trouble in pumping.

There is an average of 1 percent moisture in fuel oil, some coming from the well, the rest coming from the steam in the stills. It is of no especial importance except in making fine corrections in fuel tests.

A well-known very strict specification for marine fuel oil reads as follows:

Specific gravity between 15 and 17 Baumé.
Corresponding weight per barrel of 42 gallons, 336 pounds.
Heat units per pound of oil, 18,000.
Moisture limit, 1 percent.
Sulphur limit, ½ percent.
Silt, etc., none.
Flash point, not less than 200 degrees F.

A somewhat more lenient specification is as follows:

Specific gravity, the oil must be readily pumped.
Weight per barrel, not specified.
Heat units per pound of oil, not specified.
Moisture limit, 5 percent.
Flash point, 130 degrees F.
Sulphur limit, 2.5 percent.
Silt, etc., ½ percent.

The first oil burns beautifully, without special features, and is easily procurable in oil countries at a reasonable price. The second oil is very gasy and explosive, because of the low flash point, permitting light constituents; it often flashes back into the fire-room, because of the suddenness with which the light parts ignite; it sputters and threatens to go out because of the high percentage of moisture, and gives off very offensive sulphur fumes, because of the high percentage of sulphur, which could only be prevented by an excess of draft, and the burners clog occasionally with the ½ percent of silt. The foregoing shows the advisability of specifications for fuel oil and of purchasing from reputable firms.

It is perfectly possible for any engineer to be provided with all of the simple instruments for determining any of the following characteristics of fuel oil: gravity, viscosity, flash point and impurities. The most important are the gravity and flash point. The viscosity relates only to pumping, and the practical engineer can learn all he needs to know by spreading a little of the oil on a piece of iron warmed to about 130 degrees F. He can smell it for sulphur, as 2.5 percent will smell strong in a closed tank when at 60 degrees, and 1 percent is hardly perceptible in comparison. The flash point is taken with a very simple instrument that will be explained by any dealer in chemical goods.

Oil fuel, when adopted by a steamship company, is handled in one of four ways. Either the oil firm's scow comes alongside at a regular hour, and pumps in fuel, or the steamship goes to the oil dock, which does not take long with the huge pipes and pumps used, or, in some cases, the steamship company has a private pipe line from the oil companies' pumps, or they maintain a private supply in their own tanks. The oil may be bought under contract, and delivered according to terms, or it may be bought in lots at advantageous terms and privately stored. Also, it can be purchased in lots and ordered stored by responsible firms, but this should not be attempted by people not familiar with the business.

The Federal government has not made set rules for the carrying of fuel oil, but a combination of their practice, the reports and recommendations of their various officials, and the business as actually practiced would read about as follows:

Permission must be obtained from the Secretary of Commerce and Labor and the Supervising Inspector General at Washington, through the local inspector. Blanks will be furnished for this application, which must be accompanied with complete drawings as specified, showing in detail the proposed fuel oil tanks, with dimensions, capacities, position, etc. The tanks may be located to suit the design of the vessel, but it is not customary to put them in the double bottoms under the boilers, nor in the wing bunkers, nor is the after bunker popular, because of the many pipes, etc. General practice has included the forward bunker and double bottom under it and any space forward of this. Small boats frequently carry tanks lashed to the decks, but this is not fully approved, as these tanks sometimes get adrift in rough weather. Fairly complete specifications, with scantlings, recommendations, etc., for construction can be found in the Manual for the Marine Engineers' Beneficial Association for 1904.

To use a bunker directly it is simply calked up, a cofferdam, 2 to 4 feet deep is bulkheaded off next the fire-room, and filled with cellulose or water, to keep the oil out of the fire-room in case of collision. Then the bunker, if in a large ship, is divided into two or four tanks, or if in a small ship it is simply provided with baffle plates to keep the oil from surging. Some ships use the double bottoms throughout, but the inspectors now do not favor oil in double bottoms under the fire-rooms. Some boats use cylindrical tanks stowed in bunkers or holds, or even in the wing bunkers.

The propeller ferryboat *Berkeley*, one of the fleet before referred to, of 1,245 tons, 260 feet long, 40 feet beam, 1,600 horsepower, was converted into an oil burner from a coal

burner for $1,700 (£350). The oil is carried in four upright cylindrical tanks, 7 feet diameter by 10 feet high, placed in the corners of the old bunkers. This boat runs 18 hours out of 24 at least, and takes oil every other day. A 5,000-horsepower ocean liner that is just being changed over (the writer is not at liberty to mention the boat), by carrying the fuel in the forward bunker, and extending this four frames on one deck only, will cost about $18,000 (£3,700) to make all the alterations. This boat is being arranged to make trips of 180 hours' duration without refueling, including gross fuel used for all purposes.

In order to make use of the cheapest grades of fuel oil, and to be prepared to take any oil at any port, provision must be made to heat the oil with steam. The amount of surface necessary can be figured upon the data given in the first part of this article, also the amount of heat. In general, heating the oil in the tank is not allowed, as the temperature is cumulative up to the temperature of the heating agent, and in the course of a week or a month at sea the flash point might be exceeded, and the tank filled with gas, or the oil take fire at some leak; still, if the oil is very heavy it may be necessary to warm it some in order to handle it at all. Such oil will invariably have a high flash test of 200 degrees or more, hence could be warmed to 150 degrees with perfect safety. From 140 to 150 degrees is the point of maximum thinness for all oils; that is to say, they do not thin out perceptibly for several hundred degrees above this, hence 145 degrees may be accepted as the standard point to which it is advisable to warm oil for pumping, provided the flash test is 200 or more. This is done by putting steam coils in the car or tank, or bunker as the case may be. A good practice is to put a small coil right around the pump suction, but no more; this makes the oil flow easily to the pump, but any superfluous warm oil or gas is condensed before it has risen very far in the tank, especially in a bunker tank, with the sides next to cool sea water.

The following represents the properties of average oil:

Gravity.	Maximum Thinness Degrees F.	Flash Test.
14	150	250
16	140	240
18	110	175
20 and 22	100	130

Lighter oils than 22 are seldom used for fuel purposes, and would be most unsuitable for marine purposes on account of their volatility.

If the oil be of 18 gravity or lighter the pump and connections need not be any different than as though arranged for the same quantity of water. If, however, as is usually the case, the oil be of 14 or 16 gravity, the pump should be at least five times as large at the water end only, on account of the very low velocity necessary, and all the suction valves should have the spring tension reduced to the least possible.

In any case, a heater should always be provided between the pump and burner. It can take any suitable form, and should be constructed for a working oil pressure of 60 pounds, which is pretty well established for all systems in general use. Steam is always used for heating, and the surface proportioned according to the transmitting factor and the specific heat of the oil.

Two systems of piping are in use: the open system, in which the oil makes circles all the time through the heater and burner pipes and back to the pump suction pipe, and the dead end system, in which the oil simply goes to the burner. For marine work, the open system should be used, as in case of a shut down for some time, the oil cools and stiffens in the pipes, and if a heavy fire is wanted right away the oil does not spray so well, and carbonizes, or even backfires into the fire-room, which is very unpleasant sometimes.

Gas from the oil collects in all pockets, and provision should be made to blow it off. It should not be blown into open fire-rooms, etc., but carried overboard or into escape pipes. First-class installations now are made with central regulation; that is, instead of jumping from one burner to another the pressure on them all is controlled from the oil pump, either automatically or by hand, and any fire wanted, or no fire at all, just by controlling the oil pressure. No ells should be used in an oil system; rather all crosses, with plugs in the unused holes, so that any pipe may be readily cleaned of obstructions. All valves intended for purposes of fine regulation are specially constructed, as the ordinary market valves will not regulate in proportion to their opening. Fuel oil should be strained at every possible point, from the well to the burner, and twin Macomb strainers make a fine combination for oil fuel lines. Shut-off valves on all oil lines must be controlled from the deck, especially those next to the tank. The government makes no ruling from the time the oil leaves the pipe and enters the burner, leaving it to the judgment of the local inspectors, who in turn depend largely upon reputable firms who make the installations.

(To be continued.)

LENGTHENING THE SIDE WHEEL PASSENGER STEAMSHIP RANSOM B. FULLER.

BY ROBERT C. MONTEAGLE.

Among shipbuilders and others who are familiar with such work, it is thought that the lengthening of the *Ransom B. Fuller* was accomplished by very skillful methods, and, in addition, great care and thought were exhibited in the working out of the numerous details connected therewith. The work was contracted for and performed by Mr. William McKie, of East Boston, the vessel being one of the large fleet of passenger steamships of the Eastern Steamship Company, of which Mr. Calvin Austin is president, operating between the ports of Boston and Bath, Me.

The vessel is of wood, has side wheels, and is a passenger and freight steamship, built in 1902 by the New England Shipbuilding Company, of Bath, Me. She has three decks—main, saloon and gallery decks. Accommodations are all first-class, and are distributed on all decks, the dining saloon being on the main deck.

The machinery consists of a beam engine, with a cylinder 63 inches in diameter by 132 inches stroke. Steam is furnished by two boilers, of the fire-box, flue and return tubular type, each fitted with a steam chimney opening into one common smokestack. The boilers were built for a working pressure of 55 pounds per square inch. Before lengthening, the vessel was of the following dimensions and capacity:

Length over all	277 feet 6 inches.
Beam, molded	40.1 feet.
Depth to main deck	14 feet.
Gross tonnage	1,862 tons.
Sleeping accommodations	650 passengers.

The frames are double, 6 inches by 15 inches at the heel and 6 inches by 8 inches at the gunnel, spaced 24 inches centers. The planking is 3½ inches, the ceiling 8 inches, 6 inches and 4 inches. The diagonal strapping is ½-inch by 4-inch steel. The following is a brief description of the alterations which have been made:

Previous to hauling out, the joiner work of the vessel had been cut as far as practicable while she was afloat. On Oct. 28, 1909, she was hauled out on the marine railway at the Atlantic Works, and cut apart forward of the boilers, in the manner shown in the drawing and photographs. The forward body was then blocked up, and on Nov. 6 the cradle, with the afterbody, was hauled back a distance of 40 feet, the amount

which it was desired to lengthen the vessel. It is self-evident that by adopting this method of separating the two bodies they must be in absolute alignment, and ready for the work of filling in the 40 feet of additional length. The illustration of the lines shows that although only 40 feet were added to the length of the hull, yet in order to get fair lines it was necessary to remodel 147 feet of the hull. This made necessary the installation of fifty-two new frames complete, and the building up or reduction of those remaining in the remodeled portion of the hull.

Fig. 1 shows the vessel hauled apart ten minutes after the work was started. She had been hauled apart about 10 feet during that time.

Fig. 2 shows the vessel hauled apart the desired 40 feet. This was fifty minutes after work was started. The men who did the work are standing in front of the hull.

Fig. 3 shows a profile view of the vessel six weeks after work was commenced.

Fig. 4 shows the vessel completed shortly before making her first trip. It may be noted how fair the lines of her sheer and joiner work are, no break of any kind being visible. The launch took place on Feb. 11—no effort was made to get her ready sooner, as she was not required to run until the opening of the spring season.

Fig. 6 shows one of the Howe trusses, built into the vessel, one on either side, between the keelsons and the main deck,

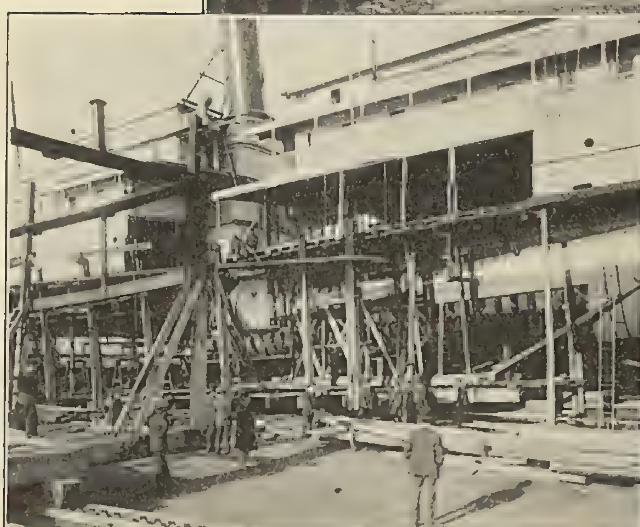


FIG. 1.

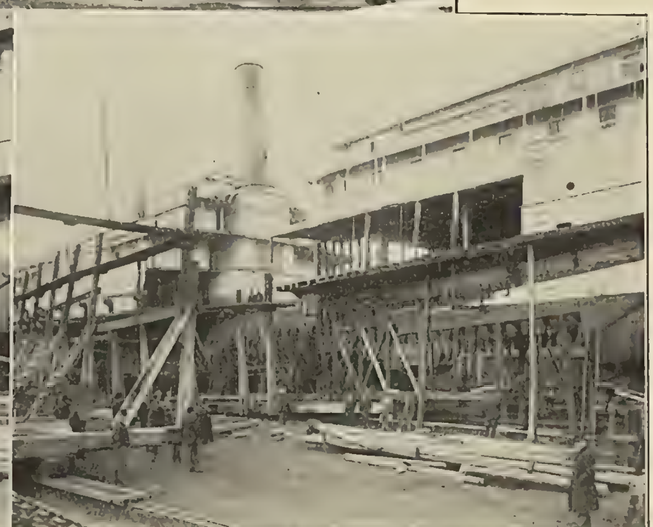


FIG. 2.

FIG. 3.—PROGRESS OF WORK AFTER SIX WEEKS.
FIG. 4.—THE VESSEL AFTER REMODELING.

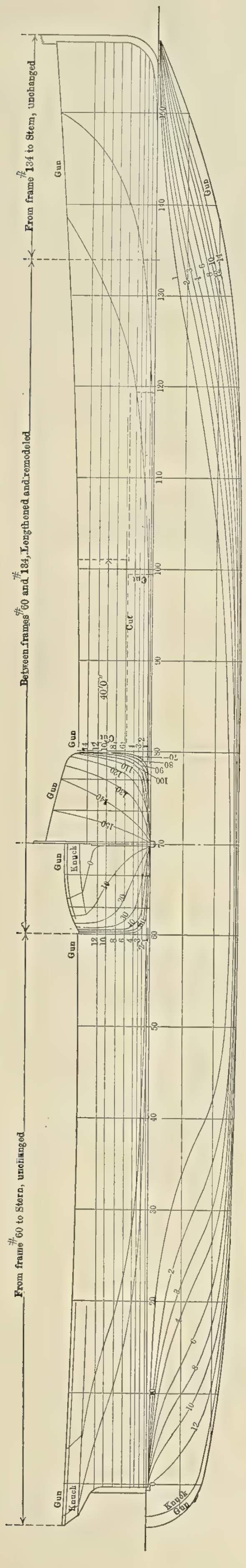


FIG. 5.—NEW LINES OF THE RANSOM B. FULLER.

making two trusses the full depth of the vessel, extending fully two-thirds of her length.

Figs. 1 and 2 show how the diagonal strapping was cut, which had to be renewed after the new frames were in place.

As altered, the vessel has eighty-three additional staterooms, constructed for two passengers each, giving sleeping accommodations for 166 additional passengers, making in all sleeping accommodations for 816 passengers besides her crew of sixty men. Ten carloads more freight can be carried than before the change, all this being carried on the main deck. The new gross tonnage is 2,329.76 tons. The draft aft is 10 feet 8 inches, and forward 8 feet; mean draft, 9 feet 4 inches—the effect upon the draft of the change being to lessen it approximately 10 inches. This of itself was very desirable, as the wheels now work at a much more effective draft.

At this writing the *Fuller* has made two trips, and the results are very gratifying. She steers better, runs faster and

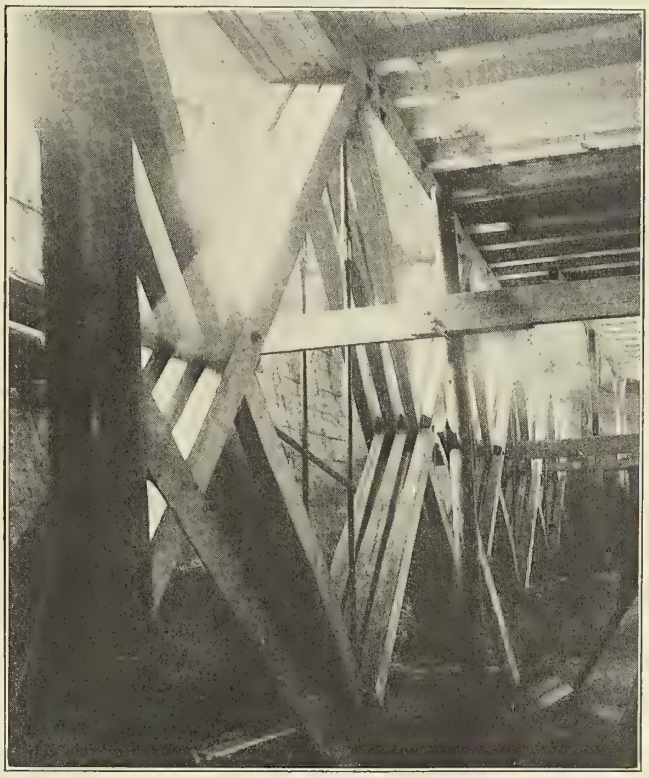


FIG. 6.—ONE OF THE HOWE TRUSSES WORKED INTO THE HULL.

makes her running distance on less coal than at any time of her career. As the vessel stands to-day she has a large increase of longitudinal strength over her previous condition; this superior strength being due to four extra heavy keelsons fitted, and to the immensely strong Howe trusses built on either side of the vessel, as illustrated in Fig. 6. To sum up, it may be said that this work of lengthening a wooden vessel was carried out with great skill and in a manner highly satisfactory to all concerned.

The Colossus, the first to be floated of the eight warships provided for in the British naval programme of the past fiscal year, was launched at Greenock April 9. The *Colossus* has a displacement of 20,250 tons, and is designed for a speed of 21 knots. The main battery comprises ten 12-inch guns, the secondary battery consisting of 4-inch guns. She was launched in nine months from the date of laying the keel. Her principal dimensions are: Length, 510 feet; beam, 86 feet; horsepower, 25,000. The *Hercules*, sister ship of the *Colossus*, building at the yards of Palmer's Shipbuilding & Iron Company, will be launched May 10.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Alterations to the Water Ends of Pumps.

While serving in one of our small cruisers in the Orient, it became necessary to overhaul and refit the water-end packing of all our main and auxiliary feed and the engine-room fire and bilge pumps. There were two main feed, two auxiliary feed and two fire and bilge pumps, all the same size, each being 9-inch by 6-inch by 6-inch double pumps, made by Watson & Son, in England. Just before leaving New York for

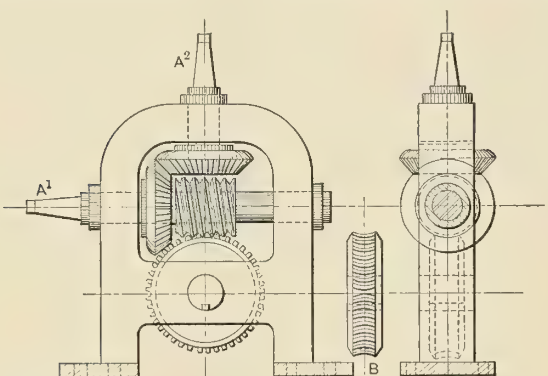
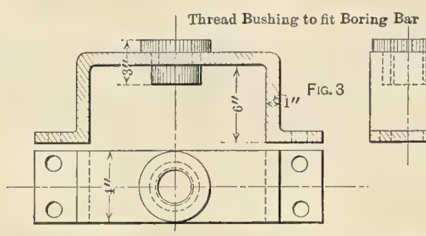


Fig. 1

Fig. 2 BORING BAR



Manila, the water ends of these pumps were rebored, each water end of each pump being left a different size, varying by sixty-fourths. They were then fitted with a solid brass packing ring, 2 inches wide, and four sets of these rings were sent on board for spares.

The job was a hurried one, and was an exemplification of the familiar saying among sea-going engineers, "that some of the people who design and build pumps and their acessories should be sent to sea with them." The pump cylinders were all bored taper, and the new rings were poorly fitted to start with, and by the time we reached Manila it took both main and both auxiliary feed pumps to keep the water up in three of the four boilers.

Upon our return to Cavite, after a voyage up the China Coast, it was proposed to take the water ends of the pumps ashore, rebore them, and fit new packing rings, the same as the old ones. As the old ones were decidedly too narrow there was nothing to be gained by fitting new rings similar to the old ones, when by a slight alteration in the water pistons and followers, rings nearly three times as wide could be fitted. When it came to take the water ends of the pumps ashore it was found that to get the water ends of the two main and the two auxiliary feed pumps out of the fire rooms would require disconnecting all of the port after auxiliary steam and exhaust piping, in order to pass the pump-ends over the top of the port after boiler, the only place where they could be passed between the boiler and the protective deck, which was of 3-inch steel. The Chief suggested that we cut out part of the front connections of one boiler, then pass them up through one of the smokestacks. But, upon investigation, this method had to be abandoned, since there was a battle-grating in the base of each stack, and this was made of 6-inch by 1-inch steel bars, securely riveted to heavy bulb iron beams.

It was then decided that if the navy yard would supply the castings we would rebore the pumps in place with the ship's force, a job which the navy yard force declined to consider, saying that they had no small boring bar, and that the ship would not remain long enough at the yard to give them time to make the bar and do the boring. The castings were procured, and, when brought on board, finished nearly to size from our drawings, except turning down to size on the outside.

Then came a hunt for something which could be rigged up for a boring bar, for 10-inch water ends are pretty large to bore out with a direct-driven bar and a No. 3 ratchet. In looking around I discovered a rig, shown in Fig. 1, that was secured to the center-line bulkhead between the engine rooms, and was for the purpose of closing by hand the two water-tight doors over the engine rooms in the protective deck. The only alteration made in this rig was to remove the original shafts and substitute two short shafts fitted with tangs, as shown, to fit our No. 2 air drill. The rest of this gear was used as taken from the bulkhead. The worm-wheel B, Fig. 1, was inserted in a slot in the frame from the bottom, and was fitted with a key that was riveted in place, and the wheel, being between two sides of the frame, took care of the thrust. The boring bar was made as shown in Fig. 2, threaded for one-half its length to form the feed, and slotted the other half to drive the cutter-head and to fit the key in the worm-wheel, to act as the drive.

As all the cylinders had to be counterbored the bracket, shown in Fig. 3, was made and the bushing threaded 20 threads per inch to act as the feed; the bracket, setting off six inches from the cylinder, allowed the cutter head to pass clear through the cylinder. The castings were furnished to our sketch and were made as shown in Fig. 5, except that they were 6½ inches long by 6⅜ inches in diameter.

We made a boring-bar from a piece of 1¾-inch machinery steel, fitted as in Fig. 2, with the exception that we fitted a tang upon the unthreaded end, to fit our No. 3 ratchet. The cutter-head, Fig. 4, and the bracket, Fig. 3, were the same as used upon the job to be described below. Each pump was bored and counterbored, and all twelve water ends were bored exactly the same size, 6¼ inches. The sleeves for the water pistons were turned to a neat fit, and four water grooves were turned into each, and these pumps gave no further trouble during the next four years.

Several years later, when, on joining one of our large armored cruisers, I found the two engine-room fire and bilge pumps, 14 inches by 10 inches by 14 inches, as well as two auxiliary air and circulators fitted with fibrous packing in the

* We pay for these articles.

water-end pistons, which gave no end of trouble, as the pump cylinders were quite badly worn. These pumps were an almost constant repair job for two machinist mates. The water-end cylinders, due to wear and having no counterbore, would cause the pumps to stick at the end of the stroke. It was decided to rebore them and counterbore them, and fit the water pistons with the sleeves, as shown in Fig. 5. The bracket, Fig. 1, was lined up, so as to stand off the cylinder face about six inches, so as to give plenty of room to set the tools. The cutter-head was made of a pair of brass blank flanges, slotted to fit the ⅝-inch square tools and bolted together, as shown in Fig. 4, by the bolts C', C'', C''', these bolts also serving to jam the tools in place when set. The tools being set out by means of a taper pin driven behind them into the holes D', D'', D'''. By this means each tool could be accurately and quickly set.

When the bar was set up and ready to start, our No. 2 air drill was placed upon the tang of shaft A^2, and the cut ran clear through the cylinder; the air drill being now reversible it was shifted to the other tang, A^1, and the cutter-head run in the opposite direction until out to the edge of the bore, then the cutters were reset and another cut taken. The cylinders were all bored and counterbored, and our improvised boring bar worked admirably. The 10-inch cylinders were bored to 10⅛ inches, and all of them exactly the same size, while the 8-inch were bored to 8⅛ inches, care being taken to finish them exactly the same size. The original pistons being fitted with five turns of ½-inch square tucks-packing. This gave but 2½ inches of bearing measured longitudinally with the bore. It was found by careful measurements that our new packing sleeves could be left 8¾ inches long. This would allow the sleeve to over travel in the counter-bore about one inch on each end of the cylinder. These sleeves were made a sliding fit between the follower and the piston, thus allowing the springs and adjusting screws to be replaced as before and the pistons centered in the same manner. But the outside surfaces of the sleeves were made a snug fit in the bore and had to be tapped in with a block of wood. The cylinders were then oiled and the pumps run "dry" for several hours at slow speed, so as to obliterate all the toolmarks. Each sleeve was fitted with six water grooves, as shown in Fig. 5, the grooves being ⅛ inch deep and ⅛ inch wide, rounded at the bottom.

Fig. 6 shows the relative bearing surface of both the old and the new packings. The first of these pistons to be finished, as shown, had been running nearly two years before I left the ship, it being one of the engine-room fire and bilge pumps, and was used on bilges and for deck purposes, as well as for evaporator circulating. At the end of this time a careful examination was made of the fit by removing the top head of the water cylinder. The bore was a perfect mirror, and by filling the pump cylinder with water, then inserting the piston and sleeve, it would not sink of its own weight, but stood for over an hour at one spot.

Even by increasing the length of the water packing sleeve, as shown, the ports still remained open, largely in excess of the area required by the size of the pipe and connections. Should it have become necessary to repair these sleeves at any future time, I would have taken a heavy cut off the outside, then turned four or five dove-tailed grooves, trimmed and babbitted the outside of the sleeves, and then turned them down to a good fit in the bore. I have since finished pump sleeves in this manner, and find the job a most satisfactory one.

It is a great deal of satisfaction to the man "on watch" to see pumps run perfectly watch after watch, after he has spent nearly every other watch repacking water pistons of pumps that were never right from the day they were started. Why pump makers will persist in sending out pumps without counterboring the water ends is apparently past finding out. But this is true of all the piston pumps, direct-acting, from the main air pumps of 38-inch bore down to the diminutive little parody on a pump of 1½-inch bore that feeds the launch boilers.

As soon as a liner becomes worn a little the pump sticks, then the oiler on watch will readjust the valve gear in order to shorten the stroke and keep it from sticking again on his watch; and, to make sure that it won't trouble him again, he shortens the stroke enough and a little to spare. It is no uncommon thing to see a pump of a nominal stroke of 12 inches making a bare 10-inch stroke. The fire and bilge pumps that I have just described were of 14-inch stroke, but were making but a 11½-inch stroke by actual measurement at the time of

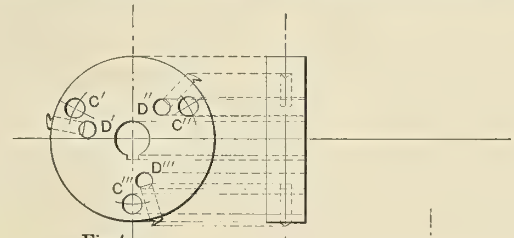


Fig.4

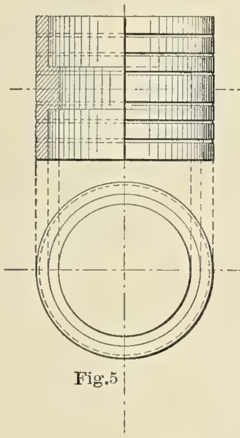


Fig.5

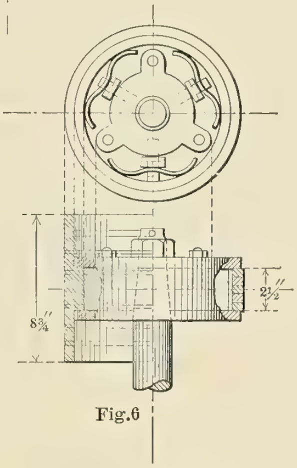


Fig.6

reboring. After the water ends had the new sleeves fitted and the steam valves overhauled and refitted they would make 14¾ inches stroke without a sign of sticking at the ends.

The hot well pumps were 14 inches by 16 inches by 16 inches, and were found to make but 14 inches stroke without sticking, but on reboring and fitting with sleeves to travel over the counter bores no trouble at all was experienced in getting them to make 17¼ inches stroke. In turning down the pistons and followers, in order to fit them to the new sleeves, enough was taken off to allow the sleeve to slide from side to side 1/16 inch, to allow for adjustment in centering when in the pumps. E. A. BLACKWELL, U. S. N.

Kingston, N. Y.

Breakdown of a Main Circulating Pump at Sea.

We left Liverpool on December 3, 1905, in a steamship bound for Calcutta, with 10,000 tons of general cargo. All went very well with us until we were just about half way up the Red Sea, going east. The main engines were running at 65 revolutions per minute when, without any warning, there was a tremendous knocking in the low-pressure cylinder. My first action was to shut steam off the main engines by throttling. I then made my way round to the back of the engines, and there I found one of the main circulating pumps stopped, and on examining it I found the connecting rod had broken just below the fork end. Steam was shut off this particular

engine as soon as I could get at it, and repairs were started as soon as possible.

Our first job was to dismantle the broken rod, and having done this we started repairing it. It was broken about one inch below the fork end. As we were on a tramp ship we were not gifted with any too much spare gear, and I might say one of the things we did not have was a spare rod. The repair of the rod was as follows: A hole 1⅛ inches diameter was drilled and tapped in each half of the rod; then a stud was put into the bottom half and the fork end was screwed into it. We started to get the engine together again and in a short time it was running once more, although at a much slower rate than before the accident.

It would be well for my readers to note that on this occasion the temperature of the sea water in the Red Sea was very nearly 100 degrees; to be correct I think it was 98, so you may well imagine the two circulating pumps had all their work cut out to keep the main engines going at a fair speed. However, it stood to our credit that the repairs effected carried us to our port and there we got a new rod. F. J. N.

Repairing a Broken Sea Valve Box at Sea.

The breaking of a boiler blow-down valve box on the ship's shell occurred with the writer in mid-ocean, heading westward. The valve box was made of cast brass and contained three valves. Each valve was connected to an independent blow-down pipe. The valve box was secured to a cast brass pedestal about 16 inches in depth, placed in the center of a fore-and-aft stokehold, between two floors on the port side of the keelson, and joined to the garboard strake plating. A corresponding valve box similarly fitted was fixed on the starboard side of the keelson. As the vessel was not supplied with an evaporator, sea water had to be used for the extra feed makeup, and when the water in the boilers exceeded a certain density they were blown down. On one of those occasions it was observed that some part in connection with the blow-down system underneath the platform had given out. An inspection showed that an inrush of sea water was coming from

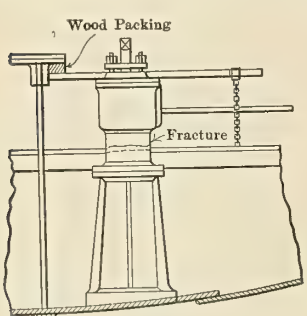


Fig. 1

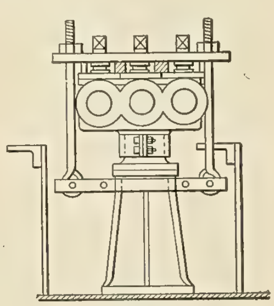


Fig. 2

a point below the body of the valve box. It was thought that the joint between the flanges of the box and the pedestal had failed, but a closer inspection showed that there was a fracture on the trunk of the valve box about 1¼ inches from the top and extending about 15 inches round the circumference, leaving about 3 inches of solid metal holding the parts together, as shown on Fig. 1. As a temporary measure, a stout bar was placed across the top of the box, one end of the bar being placed underneath the top angle bar of the keelson, and the other end secured to the valve cover by means of a Spanish windlass, as shown also on Fig. 1.

Preparations were then made for executing a lasting repair. Two half bands of wrought iron of sufficient thickness and width were forged, fitted together and fastened in position by four ½-inch bolts, with a rubber insertion joint round the fractured part of the box. When tightened up, it made a completely tight joint. A clamp equal to the diameter over the webs of the pedestal was then forged, leaving the lugs sufficiently long to project beyond the ends of the box, and bolted in place underneath the top flange of the pedestal. To the ends of the clamp lugs were bolted two prepared eyebolts, which stood up at the ends of the box. A strong back was made from a piece of plate, with clearance holes, to allow the valve spindles to pass through. The gland studs were removed, and the strong back placed in position over and resting on the glands, and on strips of hard wood placed on the valve covers, the temporary bar was then drawn out and the coupling bolts tightened up. The complete repair was as shown on Fig. 2.

With this repair the vessel completed the round voyage. On arriving at the home port, as there were no convenient facilities for docking, a diver was sent down. He took the sizes of the blow-down apertures, and two wooden plugs were made to fit them, which he took down and placed in position. The valve boxes were then removed and blind flange plates were fitted and joined on to the pedestal. In place of the valve boxes, two suitable single-way cocks were made and fitted, and the blow-down system altered to suit. The diver then removed the plugs from the ship's bottom.

JAMES BELL.

A Leaky Condenser.

I write of an incident which happened while at sea about 1,200 miles from New York, on a British Atlantic liner carrying the royal mail. I might say that this liner belongs to the premier line of Great Britain.

We left New York for Liverpool on a Saturday in October, 1908. The weather for the most part of the voyage was very rough. Being one of the engineers whose duty it was to spend much time in the stokeholds, I had occasion to take particular notice of the water in the boilers. I found on entering the stokehold that the water level in the boilers (nine in number) was rather high. At this time we were only twelve hours from New York. I returned to the engine room and examined the extra feed cocks, and found them all in good order and shut off the boilers. I once more returned to the stokehold, this time armed with a salinometer pot and salinometer and took the density of the water in the boilers. The salinometer registered 7 ounces of salt to the gallon; I came to the conclusion that this density was too high with another 5½ days to run, so I blew about 3 inches of water out of the boilers. Two hours afterwards I again tried the density and this time it had been reduced to 5 ounces to the gallon. I decided to let it go at this, for a watch at any rate. My watch now being up I was relieved and I told my relief what had happened and advised him to keep his eyes open. This he did without anything alarming having happened.

I now came on watch again, eight hours having elapsed since I left the boiler rooms. On looking at the water all around I found that it was about 2 inches higher than when I left it. I at once tried the density again and found that it was up to 8¼ ounces to the gallon this time. I became rather anxious as to the cause of this increase of water in the boilers, also at the height of the density. I had a pretty good idea that the trouble lay in the main condenser, and as I found out afterwards, I was right. I blew some more water out of the boilers, this time to the extent of 6 inches, and now watched them more carefully than ever. In the space of one hour I noticed a big increase in the height of the water in the boilers, so for the second time the matter was reported to the chief engineer.

After a short consultation we decided to stop the ship and open up the main condenser. In another half hour the ship

was stopped and before long the doors were off the condenser and the sea water was run from it into the bilges. The condenser now being dry on the seaside the trouble was at once seen and made good. The defects we found were as follows:

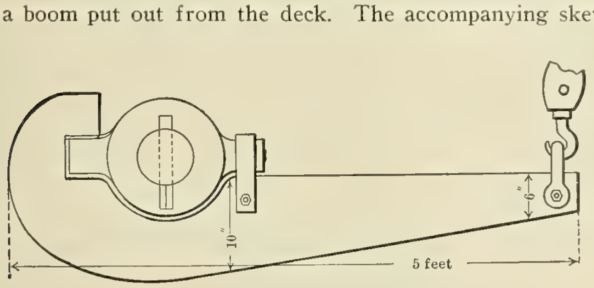
In the first place it must be known that there were two condensers and all the defects I now write of were found in the fore condenser in the fore end of it. Brass stays were passed through the condenser and adjusted at each end by a 7/8-inch brass bolt which went through a fitted hole in the tube plate and screwed into the end of the stay. Several of these stays and bolts were fitted thus to brace the condenser. It was one of these stays which was giving the main trouble. One of the brass bolts had snapped off flush with the stay end, thus allowing a large quantity of salt water to mix with the fresh. We also found that the top half of the tube plate was cracked for about 2 feet of its length vertically. We also found on further examination that about fifteen of the tubes were leaking very badly. These we plugged with hard wooden plugs. We then plugged the crack in the tube plate with hard wooden wedges. This done we were not long in getting the doors on and once more resuming our voyage to Liverpool. When we reached this port we had the defects made good, and sailed again a week later for New York.

Francis J. Nolan.

A Loose Propeller and Loaded Ship.

A short while ago, immediately on my arrival at Monte Video, a launch came alongside the steamer of which I was chief engineer and I was requested by a gentleman to accompany him on board another steamer and act as one of three surveyors to look over the machinery of that steamer. On arrival on board I was informed that the vessel was from the west coast of South America, was deep loaded and had put in with a loose propeller.

After having the entries in the log read to us, we decided that the first thing to do was to send a diver down to get the size of the nut and to see how much it had slacked back. When the diver returned from below he had the exact size and shape of the nut, taken by bending a piece of wire round it; he also informed us that the nut had slacked back about 3/8 inch and was bearing hard against the split pin. The next thing we decided to do was to have a long and substantial spanner made, to the end of which we could make fast a pair of 10-ton blocks, the other end of the blocks being made fast to a boom put out from the deck. The accompanying sketch



SPANNER AND CLIP IN PLACE.

gives the shape of the spanner and the clip arrangement for keeping it in place on the nut; the spanner was made out of 1½-inch steel plate.

The manner of tightening up the nut was as follows: As much as possible was taken up on the blocks, then the engines were turned ahead with the turning engine, the rope blocks being slacked off and the spanner end allowed to drop down below the horizontal; the turning engine was then stopped and another pull taken on the blocks, the same process being repeated until the nut was tightened hard up. The diver then went down again, removed the iron clip that held the spanner in position, then by turning the engines astern the spanner slipped off the nut and was hove on board by the blocks. We then had a 3/8-inch washer made and placed between the nut and the pin, so that it couldn't possibly slack back again.

After the job was completed, we three surveyors went on board again and gave the engines a good testing at full speed ahead and astern alternately, and, although I went to the end of the tunnel and listened, I could not hear the slightest sound of slackness. To make doubly sure we sent the diver down again with a heavy hammer and instructions to try the nut; he returned and reported it to be thoroughly secure. We then gave the captain a certificate of seaworthiness.

The greatest difficulty with the job was that the diver was not able to see anything because the water was very dirty, consequently he had to do everything by feeling, and I consider that we saved the steamer a great deal of expense, as other surveyors had refused to give a certificate until the propeller had been sighted, and as she was loaded with over 6,000 tons of cargo and drawing 23 feet of water, it would have been a costly business to discharge that to tip her, or put her into dry dock.

La Plata, Argentina. Marinero.

How a Ship Was Sunk by a Propeller.

We were on a voyage from Calcutta to Liverpool and London with a cargo of tea. We had come through the eighty-seven miles of the Suez Canal without mishap, and were just coming out of the Port Said entrance to the canal when a small collier of about two thousand tons, which we afterwards learned was on her way to meet the Russian Baltic fleet in the Red Sea and coal them, dropped anchor right in the fairway of the entrance. Our ship had a speedway on her estimated at three miles per hour. In swinging to avoid the coal ship her midship section came right under our port quarter, and we came into violent contact with one another. Our propeller, which was revolving at the time at 25 revolutions per minute, crashed through her side and opened up a huge hole into her hold where the cargo of coal was stowed.

At the time of the accident I happened to be down below, working the engines according to orders from the bridge. Without any warning the engines pulled up dead with a most fearful shake and a long groan; the latter came from the tunnel and, as we found out afterwards, was the noise made by the propeller tearing through the other ship's side. After the first shock the engines made a quick quarter of a turn. This was the second blade doing its work. Steam having been shut off the main engines, this second movement was caused by the steam which remained in the engines and by a leaky throttle. Our propeller had four blades made of manganese bronze and bolted on to a cast steel boss.

Tow boats got hold of the smaller ship and eventually, after a lot of pulling, managed to pull her off our propeller. However, before they managed to get her into shallow water she sank in a depth of water which covered the top of her smoke stack. We found on examination that we were minus a blade and a half of our propeller. In this crippled state we made our way to London and thence on to Liverpool, taking two and a half days longer on the whole run. When we arrived at Liverpool we had two new blades fitted and a week afterwards we were once more on our way to Calcutta.

F. J. Nolan.

The Naval Appropriation Bill passed the House of Representatives on April 8. This bill authorizes the construction of two first-class battleships, two fleet colliers and four submarines. It is stipulated that the battleships and colliers must be constructed by firms observing the eight-hour law. The total amount carried by the bill is $128,037,602 (£26,300.000).

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The Argentine Dreadnoughts.

Wide-spread interest has been manifested by both the technical and daily press in the contract for the two Argentine Dreadnoughts recently placed in America, and comment has been rife both regarding the conditions which enabled American shipbuilders to underbid the world for this contract and also concerning the details of the successful designs. Through information received from our special correspondent in Argentina we are able to furnish our readers with many details regarding both the contract and the ships themselves, some of which we believe have not hitherto been published.

In the first place, as far as the cost of warship construction is concerned, it is true that the cost of hull construction in the United States is approximately fifty percent greater than that in England, the lowest market in the world for this work. On the other hand, armor plate and ordnance can be manufactured in the United States at a lower figure than in any other country. Consequently, the total cost of warship construction can be made as low, if not lower, than elsewhere, and it was due to the co-operation of the shipbuilders and the armor plate makers, as well as to the excellence of the designs submitted and the satisfactory performance of the American type of turbine, that the contract was placed in America.

The placing of this contract by a nation which has added nothing to its naval strength during the last twelve years is significant, as indicating the remarkable development of the Argentine Republic since her awakening a few years ago. It also indicates that the time has arrived when naval construction is assuming a definite basis, which is likely to endure for some time to come; that is, the basis of a modern navy has now become the Dreadnought type of battleship, and nations which have been waiting during the transition period of naval construction can now proceed with more or less certainty to develop their fleets, using the Dreadnought type as the capital ship.

Eighteen firms of various nationalities sent in tenders for the construction of these ships, and these were carefully examined in London by a specially appointed committee, assisted by several well-known naval engineers. As a result of its deliberations the committee reduced the number of bidders to six, from whom the final selection was made. The following were the firms whose tenders were retained, together with particulars of the displacement, speed and price per ton named in the tenders:

Name of firm.	Displacement in tons.	Speed in knots.	Price per ton.	
Blohm & Voss (Germany)	24,900	22	$430.02	£88.3
Blohm & Voss (Germany)	25,900	22.5	432.94	88.9
Blohm & Voss (Germany)	26,900	25	426.61	87.6
Forges et Chantiers (France)	27,840	22	412.98	84.8
Forges et Chantiers (France)	25,170	22	425.64	87.4
Armstrong & Vickers (England)	29,060	24	415.41	85.3
Armstrong & Vickers (England)	28,040	22.75	425.15	87.3
Armstrong & Vickers (England)	27,840	23	422.23	86.7
Ausaldo (Italy)	25,600	22	418.33	85.9
Fore River, also New York Shipbuilding Co. (U. S. A.)	27,940	22.5	381.32	78.3

It will be seen from the above figures that the lowest of the three tenders submitted by the English company was almost equal in tonnage and speed to that of the American concern, but that the English price was $38.96 (£8) more per ton. If the Argentine government had accepted the English tender, this would have meant that each ship would have cost $1,138,362.50 (£233,750) more.

The information and full data sent to Argentina by the committee in London were carefully considered by the Minister of Marine, at Buenos Aires, assisted by the leading naval authorities there, and after careful investigation they advised the President of the Republic to give the order to the American company. The work of the construction of the two Dreadnoughts was therefore placed in the hands of the Fore River Shipbuilding Company, with the provision that one of the hulls should be built by the New York Shipbuilding Company, provided the former firm accepted full responsibility as to the standard of work, etc.

The contract for the armor and ordnance went to

the Bethlehem Steel Company, and, as stated above, it was due to the co-operation of this company with the shipbuilders that the American concern was able to quote such a favorable price for the completed vessels. A portion of the contract goes to English firms, however, as the boilers, which are of the Babcock & Wilcox type, and also the pumps will be built in England, and brought into America under bond to be worked into the ships. Each ship will cost $10,654,108.74 (£2,187,702), or the two together will cost $21,308,217.48 (£4,375,404). The stipulated time to be occupied by the construction is two years for one ship, and twenty-seven months for the other.

In design these ships represent the highest development of modern Dreadnoughts. The displacement at the normal draft of 27 feet is calculated at nearly 28,000 tons, but this will be increased to 30,000 tons when the vessels are fully equipped for war, the draft being in that case 30 feet. They will be 604 feet long, with a beam of 96 feet, and they will be driven by Curtis turbines, aggregating 39,500 horsepower, which are designed to give the ships a speed of 22.5 knots. The turbines will be located in three separate compartments, and the boilers in six compartments divided into two groups. The boilers will be equipped for both coal and oil fuel. The provision for burning liquid fuel was stipulated by the Argentine government largely on account of the recent discovery of large quantities of petroleum in the southern part of Argentina. The capacity of the coal bunkers will be such as to enable each vessel to steam 10,200 miles at 11 knots, 7,200 miles at 15 knots, and 3,600 miles at 22.5 knots. The capacity of the oil tanks will be such that the radius of action with oil will be about one-third that on coal.

The armament will consist of twelve 12-inch guns, 50 calibers in length, placed in pairs in six turrets, two forward and two aft, arranged at different levels, so that the guns in one turret can fire over the other, and two placed *en echelon* amidships, both, however, being free to fire on either broadside. The minimum height of the guns in the forward turrets above the waterline is 25 feet, and that of those in the central turrets 22 feet, while the after turret located on the poop deck is 17 feet above the waterline. These heights have been found by experience to insure that none of the guns will be forced out of action in case of heavy weather, as has been found to be the case in some earlier warship designs.

A glance at the inboard profile of these ships shows a deck practically free from superstructure of any kind, the spar deck extending from the bow for about 450 feet aft, the only obstructions, besides the turrets, being two funnels, a lattice fire control mast, and the conning towers and bridge.

The secondary battery will consist of twelve 6-inch guns, 50 calibers in length, mounted on the main deck amidships at a height of 16½ feet above the waterline. There are also twelve 4-inch guns of 50 calibers length, placed in commanding positions for protection against torpedo attack. The principal details of the armament are as follows:

	12-inch.	6-inch.	4-inch.
Weight of the projectile...........	867 lbs.	105 lbs.	33 lbs.
Initial velocity per second.........	3,000 feet	3,000 feet	3,000 feet
Force at discharge..................	16,890 tons	2,028 tons	640 tons
Speed of firing per minute........	2	4 to 8	12

Compared with the latest British and American designs, it is evident that these vessels will be the most powerfully armed ships afloat, and that, due to the excellent disposition of the guns, they offer a maximum bow and stern fire, as well as broadside discharge. The placing of the midship turrets *en echelon* is a practice which could be followed with advantage in American warships.

While the protection of a battleship is a matter of considerable dispute among the highest authorities, there is no indication in the design of the Argentine Dreadnoughts of sacrificing any advantage which may obtain with the use of heavy armor, and, in addition, there is a distinct advance in the matter of hull construction to resist torpedo attack. All the machinery and the magazines are at a distance of not less than 12 feet from the bottom of the hull, which is constructed with an extra shell and armored with nickel steel. This construction, coupled with a minute subdivision of the hull, probably represents the most distinct advance in protective features which has yet been introduced in modern warship design.

The main armor belt is 12 inches thick amidships, tapering fore and aft to 6 inches and 5 inches, respectively. This belt extends 6 feet above the waterline and 3 feet below it, and is surmounted by a belt 8 inches thick, extending to the upper deck, and above this by a belt of 6-inch armor, which forms the protection for the secondary battery The 12-inch turrets are protected by armor, varying in thickness from 7 inches to 12 inches, according to position, while the two conning towers are protected by 12-inch armor. Special care has been used in working out the protection of the machinery, boilers and stacks. A system of transverse screens and gratings of nickel steel has been introduced and the two funnels are each protected by 1½-inch steel plate for a height of 15 feet above the spar deck

To aid in economy of operation, auxiliary boilers capable of furnishing sufficient power to light the ship, operate the fire and sanitary pumps, and the cranes for taking on stores, etc., will be fitted in order to obviate the necessity of keeping the main boilers under steam when in port. It is stated that this auxiliary machinery is so arranged that it can easily be dismounted and sent ashore if considered desirable in time of warfare.

The building of the ships in the United States will be supervised by a special commission from Argentina, presided over by a rear admiral of the Argentine navy, the immediate work of inspection being in charge of three sub-committees designated for different duties.

Progress of Naval Vessels.

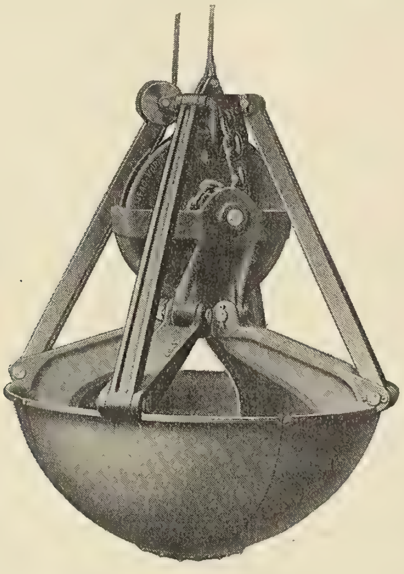
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Mch. 1.	Apl. 1.
			BATTLESHIPS.		
North Dakota	20,000	21	Fore River Shipbuilding Co..	99.1	99.7
Florida	20,000	20¾	Navy Yard, New York......	55.2	59.0
Utah	20,000	20¾	New York Shipbuilding Co...	65.2	68.5
Arkansas ...	26,000	20½	New York Shipbuilding Co...	12.5	15.7
Wyoming ..	26,000	20½	Wm. Cramp Sons............	16.9	19.5
			TORPEDO-BOAT DESTROYERS.		
Paulding ...	742	29½	Bath Iron Works............	71.8	81.1
Drayton	742	29½	Bath Iron Works............	67.4	73.6
Roe	742	29½	Newp't News Shipbuilding Co.	77.2	81.4
Terry	742	29½	Newp't News Shipbuilding Co.	76.6	79.9
Perkins	742	29½	Fore River Shipbuilding Co..	65.8	67.7
Sterrett	742	29½	Fore River Shipbuilding Co..	65.6	66.9
McCall	742	29½	New York Shipbuilding Co..	53.4	56.8
Burrows	742	29½	New York Shipbuilding Co..	53.4	56.2
Warrington..	742	29½	Wm. Cramp & Sons..........	62.7	65.5
Mayrant	742	29½	Wm. Cramp & Sons..........	64.9	69.7
Monaghan ..	...	..	Newp't News Shipbuilding Co.	14.8	17.7
Trippe	...	..	Bath Iron Works............	22.9	25.3
Walke	...	..	Fore River Shipbuilding Co..	14.0	19.2
Ammen	...	..	Fore River Shipbuilding Co..	14.6	19.4
Patterson ...	...	..	Wm. Cramp & Sons..........	10.7	12.1
			SUBMARINE TORPEDO BOATS.		
Salmon	...	..	Fore River Shipbuilding Co..	91.0	91.7
Seal	...	..	Newp't News Shipbuilding Co.	45.4	47.1
Carp	...	..	Union Iron Works..........	43.3	45.7
Barracuda ..	...	..	Union Iron Works..........	43.1	46.1
Pickerel	...	..	The Moran Co..............	40.25	43.3
Skate	...	..	The Moran Co..............	40.25	43.3
Skipjack	...	..	Fore River Shipbuilding Co..	31.3	35.3
Sturgeon ...	...	..	Fore River Shipbuilding Co..	30.9	34.7
Tuna	...	..	Newp't News Shipbuilding Co.	19.8	21.2
Thrasher ...	...	..	Wm. Cramp & Sons..........	3.1	4.3

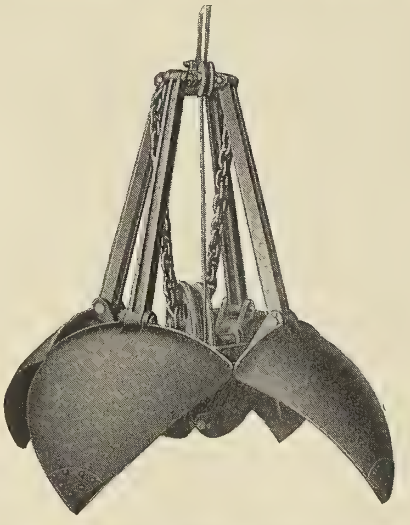
ENGINEERING SPECIALTIES.

An Efficient Orange Peel Grab Bucket.

A useful and efficient grab bucket for use in connection with dredging and digging operations is manufactured by the Mead-Morrison Manufacturing Company, Cambridge, Mass. This bucket, which is illustrated both open and closed, is constructed of a small number of parts, and rivets, bolts and such



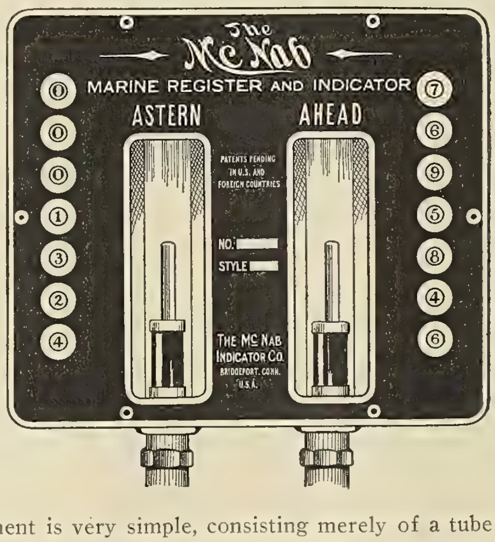
parts as are liable to become loose have been eliminated. The closing chain is a standard crane chain and not a chain of special construction, and therefore the chain can be readily renewed and repaired by any good blacksmith. The closing wheel about which this chain winds is bronze bushed, provided with an internal oil reservoir and mounted on a stationary shaft carried in the lower pivot head, this construction affording liberal bearing and wearing surface in place of the small and inadequate surface provided in some other designs. The closing wheel around which the rope winds is cast iron, forced on a cast steel sleeve, about which the chain runs, the sleeve being the part mentioned above, which is bronze bushed. It is claimed that the strain in both strands of the closing chain is automatically equalized at all times by the passing of the closing chain over a saddle in the top pivot head instead



of using two independent chains independently fastened. All parts of the grab except the closing wheel on which the closing rope runs are steel castings, and the tips or points for the shell segments or blades are made of manganese steel. These grabs are regularly bronze bushed throughout.

The McNab Marine Register and Indicator.

This instrument is designed to show in any part of the vessel where it is installed the exact manner in which the main engines are running, whether ahead, astern, at slow or full speed, etc. It has been evolved to eliminate the human risk which always exists where orders must be passed along from one to another by indirect methods of communication. The



instrument is very simple, consisting merely of a tube of iron with an air agitator at one end at the engine and a small piston at the other. The agitation of the air in this tube by the revolution of the shaft sends the piston up and down and moves the small indicator piston and register up and down. The engine of the ship cannot move without operating the agitator. The latter operates the small piston at the ahead or astern dial, causing the piston in the dial to rise and fall at each revolution. Its action begins with the first revolution of the propeller and continues as long as the engines are in operation, and shows the speed at which the engines are turn-

ing. The indicators can be placed at various points throughout the ship, wherever advantageous, and it is claimed that excellent results have been obtained even when the instrument was installed as far away from the engine as 1,000 feet. This device is manufactured by the McNab Indicator Company, Bridgeport, Conn.

Zynkara.

Zynkara is a solution of metallic zinc designed for use in marine boilers to supersede the use of metallic zinc plates to prevent pitting and corrosion. Since Zynkara is applied in solution it immediately distributes itself throughout all parts of the boiler, and thus is equally effective on each part of the boiler surface; whereas when metallic zinc plates are used they only give adequate protection to neighboring parts of the boiler. It is claimed that this compound reacts directly on the feed water of the boiler, preventing any chemical, and therefore any magnetic, action in the boiler, also destroying all oily matters which pass over from the cylinders, therefore preventing the deposit of such impurities on the furnace crowns and other dangerous parts of the boiler. It is also claimed to remove scale from boiler surfaces and replace it with a thin shell-like enamel or coating which is continually being thrown off and again being replaced, thus reducing time and cost of cleaning boilers to a minimum. Since Zynkara can be applied to a boiler daily while the boiler is in operation the engineer can always be sure that his boiler is protected; whereas, if metallic zinc plates are used they can only be renewed in port and may have become so corroded and covered with scale before port is reached as to have become practically useless. The compound is manufactured by the Zinkara Company, Ltd., Newcastle-on-Tyne.

Sturtevant Electric Forge Blower.

The Sturtevant electric forge blower, manufactured by the B. F. Sturtevant Company, Hyde Park, Mass., is composed of a pressure fan of the multi-vane type inclosed in a pressed steel plate casing driven by a direct-connected electric motor built to operate from electric lighting circuits. The particular features of this blower set are compactness and high efficiency,

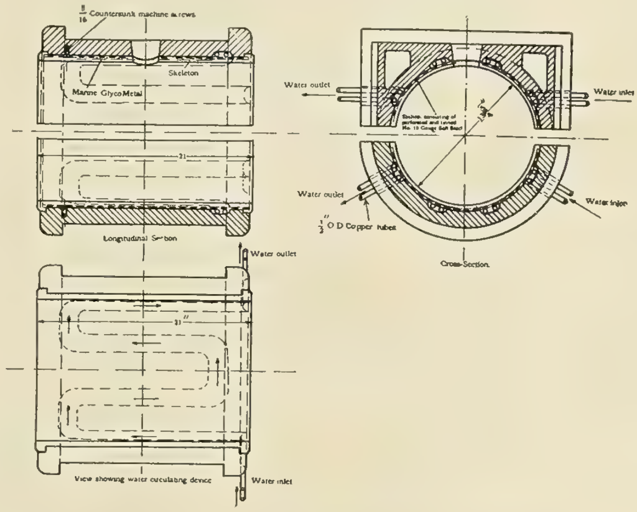
which it is claimed have been secured owing to the use of the multi-vane type of fan wheel. The principle on which this wheel is constructed is that of using many narrow blades in conjunction with a large air inlet. The illustration shows the installation of one of these sets connected to two forges. It is claimed that the same advantages can be gained by using individual blowers in forge work as can be obtained by using individual motors in driving machine tools, etc.

The blowing set weighs 35 pounds, measures 14½ inches from the floor to the top of the fan case, and 10 inches from the inlet of the fan to the outside end of the motor shaft. It can be installed to suit the requirements of individual cases as to location, etc.

The company claims that with this blower connected to a forge with a tuyere area of 1.5 square inches, a 2-inch, round, soft steel bar can be brought to a welding heat in 4 minutes and a 1-inch bar in 2½ minutes.

Glyco Bearing Metal.

Glyco is a scientifically-made bearing metal, which is designed to replace the tin white metal composition commonly used for lining bearings. Bearings lined with tin and bronze alloys have been satisfactory practically, but they have the commercial drawback of being far more expensive than a lead base alloy, and are subject to violent fluctuations in price according to the market. It was in the search for a lead base alloy having equal or superior properties to tin base metal and, at the same time, the advantage of cheapness, that Glyco was invented. Tests of this metal in comparison with a high tin



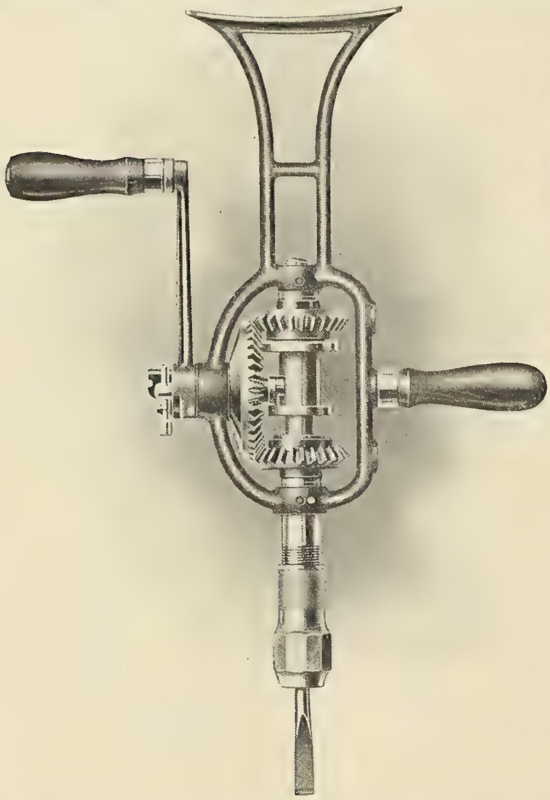
alloy have shown that both metals stood about the same pressure per square inch, namely, up to 700 pounds in duration tests and 900 to 1,000 pounds in short runs. Glyco was shown to have a superior and very high uniformity and homogeneity. It also gave a 15 to 30 percent lower friction curve than the high tin alloy. The tests also showed that in case of lack of oil Glyco will not melt out quickly, as does the tin alloy, but will only stick to the journal without damaging it; and, further, that this occurs at a higher temperature than that which causes the melting of the high tin alloy.

The illustration shows the main bearing of a marine engine shaft equipped with Glyco metal and the Glyco patented skeleton construction. The skeleton consists of a No. 10 perforated and tinned soft steel sheet. If desired the skeleton may be made out of bronze instead of soft steel. A special feature of this bearing is the water-cooling device. The cored channels and water-jackets generally used are done away with, and a pair of copper tubes, ½ inch outside diameter, are inserted in grooves in the cast iron bearing surface. The skeleton protects the tube from possible injury. When the Glyco is poured in, the tubes are firmly embedded in the liner, and the cooling device is thus brought near the surface bearing.

Glyco metal is being placed on the market by Joseph T. Ryerson & Son, Chicago.

Ashcroft Combination Valve Grinder.

The Ashcroft combination valve grinder has been designed to meet the demand for a handy, light, compact and durable tool for service on automobiles, motor boats, etc. Leaky valves on a gas engine mean poor compression, inability to start the motor on a spark, greater fuel consumption and loss of power and efficiency. The necessity for having an efficient tool to



grind valves is therefore apparent, and it is claimed that this grinder, because of its unique action, insures a means of grinding valve seats smoothly and absolutely true. The action peculiar to this grinder is an oscillating one, with the arc of oscillation gradually advancing to the right, which prevents the cutting of grooves. The tool can also be used as a breast drill or ratchet. It is being marketed by Manning, Maxwell & Moore, 85 Liberty street, New York.

Apprenticeship Certificates.

Manufacturers are always looking out for some means of awakening ambition and inspiring better and more faithful service on the part of their employees, especially of the younger men who are trying to learn the business. One of the best aids for this purpose which has recently come to our attention is the apprenticeship certificate given by the Bantam Anti-Friction Company, Bantam, Conn., makers of ball and roller bearings of all types, to the boys in their shops who have served their full three and one-half years' apprenticeship. The certificate states that "The recipient has duly served his full term as an apprentice in the machine shops of the above company, and has had all instructions possible in the operation of lathes, milling machines, drills, shapers, grinders, tool making, bench work and other practice usually found in machine-shop work. We can safely recommend him as a good and worthy machinist, reliable and conscientious in all of his work."

It is needless to say that a certificate of the above character, signed by the president and manager of the company, is a thing to be highly valued by the apprentice, and the company states that it has proved a very good incentive for work and something which the young men appreciate very much.

The Star Condenser Packing Tool.

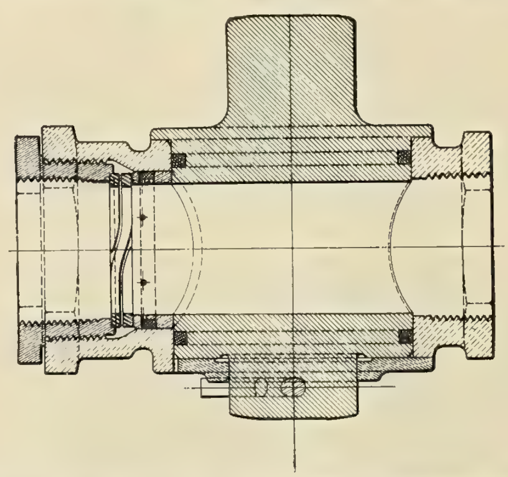
A marked reduction in the time required for the packing of condenser tubes may be made by the use of the tool shown in the illustration. In its construction the straight portion of the pointed center which telescopes in the body of the tool is of the same diameter as the condenser tube. When using the tool one end of the packing which has been cut to the proper length to fill the stuffing-box is pushed to the bottom of the box and given about one-half turn around the tube. The tool is then placed against the end of the tube, the helical spring allowing the outer shell to slide to the bottom of the box. The

free end of the packing is then passed under the lip of the outer shell, and the tool is turned by a breast drill, brace or cross handle, and the packing automatically packs itself in the box.

On the United States cruiser *Pennsylvania* 1,200 tube ends were packed in five and one-half hours. Condensers have been packed with this tool and a water pressure of 5 feet head put on before the glands were screwed up without showing a leak. It is made for all sizes of tubes by Matteson & Drake, 24-26 Stone street, New York City.

The Caskey Compressed Air Valve.

The illustration shows a valve which was originally designed for hydraulic use and developed under a pressure of 10,000 pounds per square inch. This valve has been found to be equally effective at low pressures and has been adapted to compressed air pipe lines. The valve has a straight-through opening equal to the area of the hose with no change of



direction, so that there is no opportunity or tendency to choke. An adjustable sealing plug, which automatically takes up any slight wear, serves to keep the valve tight under all pressures. As the packing is not exposed it is claimed to be practically indestructible. These valves are made of manganese bronze in all sizes, from ¼ inch to 3 inches, by the Caskey Valve Company, 99 John street, New York.

Howdens' Forced Draft System on Dredgers.

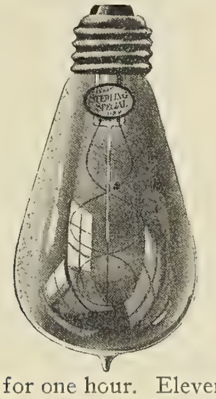
One factor which it is claimed has had much to do in bringing about the unusual results in economy and efficiency obtained with the two Bombay reclamation dredgers *Jinga* and *Kalu,* descriptions of which can be found in the May, 1909, and current issues of International Marine Engineering, is the installation of Howdens' patent system of forced draft in connection with the boilers. This system of forced draft has been widely adopted by the leading steamship companies of the

world for a good many years, but it has not been adopted to any extent in dredgers. It is claimed that the unusual advantages which this system entails in the way of increased economy of fuel and increased steaming power of the boilers would be even more marked in the case of dredgers where the load is fluctuating and where specially heavy demands for steam are occasionaly required. This system is installed by James Howden & Company, Glasgow.

Effect of Wireless Induction upon Lamps.

A recent complication in the electric lighting of ships was introduced with the wireless telegraph. It was observed that the high induction of the wireless had a serious effect upon the lamp renewal expense of the Graham & Morton Transportation Company, and extensive tests were made by them to find a lamp for service with this high induction.

Twelve different makes of lamps were tested, among them the Sterling Special, a spiral filament type, made by the Sterling Electrical Manufacturing Company of Warren, Ohio. Three lamps of each make were tested, each being subjected



to the high induction for one hour. Eleven of the twelve types of lamps tested failed to withstand this severe test. The filament of each type would spread, hit the glass and blow out. At the end of the test it is claimed that all three of the Sterling special lamps were burning and were in perfect condition. On board ship the Sterling special lamp has now, besides the advantage of 16 candle power in all directions, the additional advantage above referred to.

PERSONAL.

FRANK MCMURDIE, superintendent of the American Blower Company's Detroit plants since about 1894, has resigned, his resignation taking effect March 31. After a short pleasure trip he will take the general superintendency of the Clarage Foundry & Manufacturing Company, of Kalamazoo. Mr. McMurdie was one of the oldest employees of the American Blower Company, having entered their employ in 1883.

WALTER M. MCFARLAND, who has been associated with the Westinghouse Electric & Manufacturing Company since Jan. 1, 1899, has resigned to accept an official position with the Babcock & Wilcox Company. Mr. McFarland has occupied the office of acting vice-president for the Westinghouse Electric & Manufacturing Company for a period extending over ten years. In this capacity he has had official supervision of the large contracts of the company, as well as being the advisory head in all the co-operative movements of the company with the associated Westinghouse companies involving literature, advertising and exhibition work. Mr. McFarland was born in Washington, D. C., in 1859. His education was received in the public schools of Washington, the preparatory department of Columbia University and the United States Naval Academy. He entered the latter institution as a cadet engineer in 1875, and in 1879 was graduated second in his class. In 1881 he was commissioned as assistant engineer; in 1891 as past assistant engineer, and in 1898 as chief engineer. After having had wide experience in sea service, he was detailed for service in the Bureau of Steam Engineering in 1882. From 1883 to 1885 he was detailed from the navy as assistant professor of mechanical engineering at Cornell University, and during the years 1885 and 1886 he was occupied with the inspection of machinery then building, and with work on preliminary design for proposed vessels. From 1889 to 1894 he was again attached to the Bureau of Steam Engineering. This experience, together with his experience in the affairs of the Westinghouse Electric & Manufacturing Company, admirably fit him for the duties which his connection with the Babcock & Wilcox Company will impose upon him. Mr. McFarland was vice-president of the American Society of Mechanical Engineers in the year 1907, and at the present time is vice-president of the Society of Naval Architects and Marine Engineers.

TECHNICAL PUBLICATIONS.

The Directory of Shipowners, Shipbuilders and Marine Engineers, 1910. Size, 8½ by 5½ inches. Pages, 792. London, 1910: The Directory Publishing Company, Ltd.

This useful directory has now reached its eighth year of publication, and the present edition has been thoroughly revised and brought up to date; an addition of some fifty pages being made. The publishers have devoted an immense amount of care in making the particulars given as accurate and up to date as possible, and also in arranging the book to facilitate reference to any vessel, owner or builder, with a minimum of trouble. By means of this Directory one can instantly secure particulars of the output, personnel and vessels of any shipbuilder or marine engineer; the personnel, fleet and important details concerning the vessels of the shipowners. The personal and boat index enable instant reference to the leading men in the shipowning and building worlds, and also their vessels. The usefulness of the book is undoubted, and we imagine it to be indispensable in a large number of offices.

Marine Engine Indicating. By C. S. Linch. Size, 6 by 9 inches. Pages, 163. Numerous illustrations and supplementary folding plates. Boston, 1910: American Steam Gauge & Valve Manufacturing Company. Price, $2.

This book will be heartily welcomed by marine engineers, as it is a thoroughly practical book, written exclusively for marine work. It is not filled with page after page of theoretical mathematical work, but has reduced the theoretical consideration to the smallest practical limits, and has given page after page of practical data taken from various marine engines under almost every condition of service. It is true that the book is incomplete in that it considers only one type of indicator, and that the one manufactured by the publishers of the book, and to this extent it is, of course, in the nature of a catalogue.

The space taken up by the description of the instrument and method of handling it is, however, comparatively small, and is confined to the first chapter. The remaining three chapters take up, respectively, the computation and combination of diagrams, modern marine engine practice, from a single-cylinder to a four-cylinder, triple-expansion engine, and the construction and use of valve diagrams. Nearly 75 pages are taken up with reproductions of actual cards with the tabulated data obtained from them. This series of diagrams is representative of modern marine engine practice, and the data are sufficiently complete to enable a thorough analysis to be made. Some valuable plates of large size are also included in the book, which show the construction of valve diagrams, combined indicator diagrams as well as a sectional drawing and the general arrangement of a triple-expansion engine showing the indicator reducing motion, etc. Tables of hyperbolic and common logarithms of numbers from 1 to 1,000 are also included.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

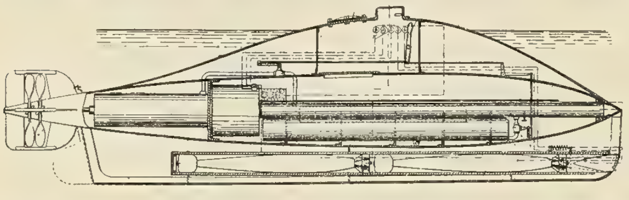
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

946,659. DEPTH-REGULATING MECHANISM FOR MOVING VESSELS. GREGORY CALDWELL DAVISON, OF QUINCY, MASS.

Claim 1.—A depth regulating mechanism for moving vessels having a movable element subjected to the pressure of the water of submergence, in combination with a float displacing a heavy liquid and connected to move the movable element against the said pressure, a depth-controlling rudder, and connections from the movable element to the rudder. Four claims.

946,944. TORPEDO BOAT. HUDSON MAXIM, OF NEW YORK, N. Y.

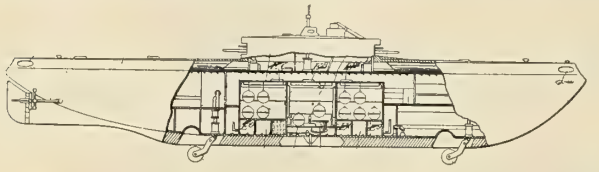
Claim 1.—The herein described process of launching automobile torpedoes from a tube within which they are immersed in water, which consists in utilizing the combined action of the propellers of the same



and the expansive force of the escaping motor fluid acting upon the torpedoes at their rear to impart the launching movement thereto. Four claims.

947,921. SUBMARINE VESSEL. SIMON LAKE, OF BRIDGEPORT, CONN.

Claim 1.—In a submarine vessel, a hull, and an air-tight compartment arranged centrally therein and having partitions to divide it into storage compartments and an intermediate diving or mine-planting compartment, the center of volume of which is arranged in vertical alinement with



the center of gravity and center of buoyancy of the vessel, a launching tube arranged and opening within said diving or mine-planting compartment, and means to supply compressed air to said diving or mine-planting compartment to exclude the water therefrom during the time said tube is open. Fourteen claims.

947,230. MOORING FOR MINE-ANCHORS, ETC. CHARLES R. GABRIEL, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

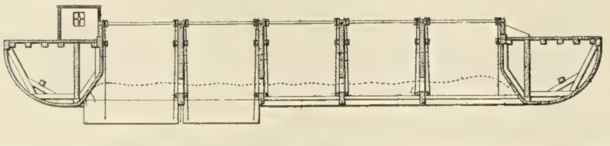
Claim 1.—The combination with a buoyant mine, an anchor therefor, and a mooring cable, of means applied to the anchor for engaging the cable to connect the anchor and mine through a required length of cable, means for operating said engaging means before the descending anchor strikes bottom, and means for rendering said operating means inoperative until the anchor is submerged to a prescribed depth. Fifteen claims.

947,624. DREDGING APPARATUS. JOHN OSTERVOLD, OF WESTPORT, ORE., ASSIGNOR OF ONE-HALF TO JOSEPH R. BURKE, OF CATHLAMET, WASH.

Claim 1.—In dredging apparatus, spaced supports, a series of floats arranged between said supports, an endless, flexible band arranged between said supports, means for operating said band, pulleys for guiding the upper run of said band, and connections between the pulleys and said floats, the lower run of said band being arranged to move in contact with the obstruction to be removed. Three claims.

950,242. DUMPING SCOW. WILLIAM W. ROBINSON, OF PHILADELPHIA, PA., ASSIGNOR OF ONE-HALF TO JOHN H. MATHIS, OF PRIMOS, PA.

Claim 3.—A scow having a central opening divided into a plurality of compartments connected below the water line for no load; the forward



wall of the forward compartment being forwardly inclined toward the bottom of the scow, and each of said compartments being provided with a swinging bottom. Four claims.

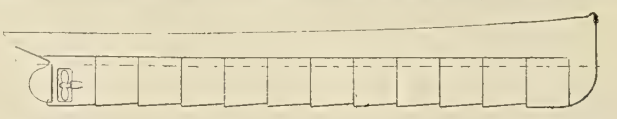
950,860. SHIP CONSTRUCTION. ABEL L. MOONEY, OF SOUTH ORANGE, N. J.

Claim 7.—In a device for relieving a ship's hull from skin-friction, means for interposing a stratum of air between the bottom of said hull and the water and means for equalizing the pressure of air throughout said bottom. Fourteen claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

1,447. REDUCING THE WATER FRICTION OF SHIPS AND BOATS. T. O. SMITH, SOUTHAMPTON.

It is known that if, by external means, together with the motion of the vessel, air can be introduced between the skin of the vessel and the water normally in contact with it there will be a consequent reduction of the resistance due to fluid friction and a corresponding increase of speed. This invention consists in arranging the plating or the planking in conjunction with the framing so that the outer surface, from a point



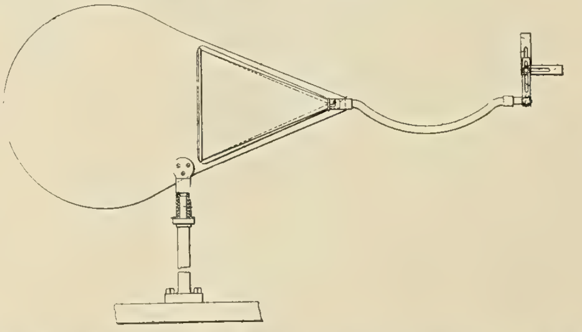
just above the usual line of flotation downwards, presents to the water a series of inclined surfaces with corresponding notches or steps arranged at right angles. At a low speed the water will eddy round the steps. At a higher speed the cavitation behind the steps induces air to descend the notch from above the water line and take the place of the water, which ceases to form an eddy and flows more evenly from plane to plane.

3,084.—ANCHORS. H. G. TAYLOR, WOLVERHAMPTON.

By making the anchor as shown, that is, with the two arms and the wing plate separately from one another to form the head, and secured to the shank by the wing plate and wedge, the parts can very readily be forged or made as sound steel castings, and there is very little work in fitting them together.

4,152. AN APPARATUS FOR LOCATING SOUNDS IN THE DARK OR IN FOGGY WEATHER. H. A. J. RANG, NEWCASTLE-ON-TYNE.

The instrument comprises a pear-shaped plane or interceptor having on each side a trumpet and transmitting pipe and rotatively mounted on a standard. The pipes at their other ends have resonance boxes secured to a frame adapted to hold the boxes to the ears. When it is



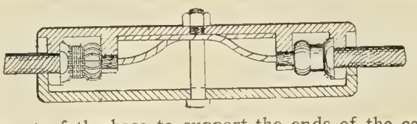
desired to locate a sound the eyes are shut to sharpen the sense of hearing and the apparatus slowly rotated until the sounds are of equal volume. This determines the position of the source, which will be in line with the intercepting part.

9,053. APPARATUS FOR CONVEYING DIRECTIONS FROM THE LAND TO SHIPS IN RIVERS, HARBORS AND THE LIKE DURING FOGGY WEATHER. J. ORLAY, TEMSCHE, BELGIUM.

The invention has for its object to facilitate the navigation of ships when passing out of rivers, harbors, etc., during foggy weather, and comprises a rope or the like carried, over a pulley arranged on the ship, to a bicycle, automobile, etc., running near the course at the same speed as the ship, and reels or drums carried by the vehicle, through the rotation of which in the one or the other direction the cable is wound off one drum and on to the other, so that directions as to the course to be followed may be constantly conveyed from the land to the ship.

10,052. MEANS FOR JOINING THE ENDS OF SUBMARINE OR OTHER TELEGRAPHIC AND LIKE CABLES. J. F. DYSON, MANCHESTER.

The invention relates to a device by which the ends of the cable can be easily and quickly prepared for joining and be held securely in position during the joining on at other times. The device is made in two parts, one, acting as a base and the other as a cover, upstanding slotted



lugs forming part of the base to support the ends of the cable. Flanged collars are located between the lugs and are mounted on the cables, and to these the armouring can be secured, such collars preventing longitudinal displacement of the cable ends and also rotary movement.

11,581. RESERVE PROPELLERS FOR STEAM AND OTHER POWER-DRIVEN SHIPS. C. WILLSON, GREAT GRIMSBY.

The invention consists mainly in the arrangement of a water-tight chamber in any suitable position adjacent to the main propeller and surrounding the propeller shaft so that a reserve propeller may be secured to the shaft when desired, the chamber being adapted to be thrown open to the sea. In case of a breakdown of the main propeller, the chamber is entered by way of a manhole and the reserve propeller fastened to the old shaft or to a new tail shaft, a piece of the old tail shaft being, if necessary, sawn off to allow fitting the reserve shaft. Then, after removing all the supports of the reserve propeller, the bolts securing the side plates to the plates of the vessel are removed. The chamber is then vacated and the manhole closed up. The temporary retaining means are then loosened and the side plates fall away and may either be allowed to drop into the sea or be hauled on board.

International Marine Engineering

JUNE, 1910.

BULK-OIL STEAMSHIP J. A. CHANSLOR.

There has just been completed at the yards of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., for the Associated Oil Company, of San Francisco, Cal., the large bulk-oil carrying steamship *J. A. Chanslor*. The *Chanslor* is the second large oil carrier built by the Newport News Company for the Associated Oil Company for service on the Pacific Coast, the other being the *W. S. Porter*, a vessel of about the same capacity, built in 1906. Both the vessel and her machinery have been built to class 100-A-1 Lloyds, under special survey, and in construction, equipment and outfit represent the highest type of bulk-oil carrier. The principal dimensions are as follows:

Length over all	400 feet 6 inches.
Length on waterline	384 feet 2 inches.
Beam, molded	52 feet.
Depth, molded	30 feet.

On 23 feet draft the vessel has a deadweight carrying capacity of about 6,600 tons.

The general arrangement of the vessel is well illustrated on the accompanying deck plans and her general appearance by the accompanying photographs. From them it will be seen that in common with the majority of bulk-oil carriers the machinery is located at the stern of the vessel, and the body of the vessel is given over to the oil tanks. Of the latter there are five-cargo tanks, each sixteen frame spaces in length, and one fuel-oil tank 10 frame spaces long, all of the tanks being sub-divided by an oil-tight centerline bulkhead, thus making twelve separate oil-carrying compartments. In addition, on each side of the vessel, in the wing space outboard of the expansion trunk, there is one compartment arranged for carrying oil in summer. There are also settling tanks built into the hull on each side of the boiler room. The pump room is located between the oil tanks and the boiler room, and is separated from the former by a cofferdam two frame spaces in width. A dwarf cofferdam is fitted at the forward end of the oil tanks. There is a double bottom forward between the forepeak and the oil tanks, and one is also fitted aft of the after cofferdam under the pump room and machinery spaces. The forepeak tank and double bottom forward are arranged to carry either fresh water or water ballast; the afterpeak and the double bottom aft are arranged to carry fresh water. The space between the collision bulkhead and the forward oil compartment is arranged for carrying general cargo, there being complete lower and main decks in this space, the whole being fitted with cargo battens and close ceiling fitted on the tank top. Cargo space is also provided in the 'tween deck space outboard of the expansion trunk forward and aft of the summer tanks.

FIG. 1.—VIEW ON THE MAIN DECK OF THE J. A. CHANSLOR.

The vessel has a raised forecastle, open bridge and an enclosed poop. It is schooner rigged with three pole masts, each mast having cargo booms attached and fitted with staysails and trysails. There are three booms on the foremast, two on the mainmast and one on the mizzen, the boom on the latter being used for handling engine-room weights.

The construction of the vessel in way of the oil tanks is in general what may be called standard for bulk-oil carriers of the larger type. The side frames are channels extending from the keel to the main deck, where they are cut and angle-frames fitted between the main and upper decks. Web frames 20 inches wide are spaced four frame spaces apart, and there are three side stringers and two keelsons on each side of the centerline. All beams are channel section. An unusually large expansion trunk is fitted for the full length of the oil tanks. It is 24 feet wide, and extends from the main deck to 3 feet 9 inches above the upper deck, the effect of this being to materially increase the range of stability. The raised trunk has been very advantageously used for the running of the oil discharge piping on top of the trunk, and all conduit, etc., has been run along its sides. The piping on top of the trunk is all protected by galvanized ribbed plates, these plates also forming room being finished in paneled quartered oak. Quarters for the other engineers and for the other members of the crew are located under the poop deck, those for the engineers being finished in oak, the bulkheads in all cases being of steel. A bath room for the engineers is provided. There is a mess room for the engineers and officers, and a separate mess room for the crew. The galley is located at the forward end of the poop and has a steel skylight over. Steel skylights, with hinged shutters, are also fitted at the sides of the engine and boiler casings on the poop deck to light the passages below. An idea of the whole general high-class character of the vessel may be obtained from the fact that the whole of the poop deck is laid with a calked deck of teak.

DECK MACHINERY.

A refrigerating plant for the ship's provisions is provided,

FIG. 2.—NEW BULK OIL-CARRYING STEAMER BUILT AT NEWPORT NEWS FOR THE ASSOCIATED OIL COMPANY OF SAN FRANCISCO.

runways from the bridge forward and between the bridge and poop, thus obviating the necessity for fitting a flying bridge.

Accommodations for the officers and crew are very complete. Amidships, in a steel house on the bridge deck, are located the dining saloon with attached pantry, the captain's stateroom, office and private bath, a spare room, staterooms for deck officers, also an officers' bath and two separate toilets, On the upper bridge deck is a teak house containing separate wheel room and chart room, access to which is obtained by enclosed stairs from the passages in the bridge house.

The dining saloon, captain's quarters and spare room are paneled in mahogany; the wheel house and chart room in teak, and the other quarters are finished in oak. Leather upholstered seats are provided in the majority of the rooms; folding lavatories in the captain's and spare rooms, and a brass bed in the latter. In the pantry there is a steam table and a coffee urn, in addition to other customary outfit.

The forward end of the upper bridge deck is enclosed to form a navigating bridge, the front and ends being fitted with sash, thus forming a very efficient wind shield, as is well illustrated in Fig. 2. A flying bridge is also fitted at the level of the top of the wheel house.

A stateroom for the chief engineer and a wireless room are located in a steel house on the poop deck; the chief engineer's

the cold-storage rooms being located on the main deck aft of the engine room, and a 2-ton ammonia compression machine, supplied by the Vulcan Iron Works, of San Francisco, Cal., is provided for circulating the brine through coils in the rooms. There is a very elaborate electric plant provided, consisting of three generating sets of 5, 7½ and 10 kilowatts capacity, respectively. These are all direct-connected sets of the General Electric Company's make and are located in a separate room abreast the engine casing on the main deck. A 14-inch searchlight is located on the flying bridge.

The steam-steering gear is of the Hyde screw-gear type, having an engine with 8-inch by 8-inch double cylinders controlled by hydraulic telemotor from the wheel house, the flying bridge and also at the engine itself. Auxiliary hand gear is also fitted with steering wheels located above the poop deck. In addition there is an emergency gear by means of which the vessel may be steered through the medium of the after steam capstans, the shafts of which are extended through to the upper deck and provided with drums for this purpose.

There is a Hyde steam windlass for handling the Baldt stockless anchors, the windlass being located on the forecastle deck and the engine on the deck below. The latter also drives a steam capstan which is located on the forecastle deck. On the poop deck there are fitted two Hyde warping capstans, which

are operated by a double 8-inch by 8-inch engine. There are also fitted two Hyde compound geared 8-inch by 10-inch winches, which are used for warping purposes. It will be seen from this that there are abundant facilities for warping and mooring the vessel, a special feature having been made of this point and an unusual number of large, heavy bitts and chocks provided. These were necessary to suit the exigencies of the trade in which the vessel will be employed, there being strong wind and tide conditions to contend with.

boats, bituminous covering on all exposed steel decks, and an engineers' workshop. The latter has a 20-inch by 14-inch lathe, a 22½-inch drill press and a No. 2 Northampton double emery grinder, all the tools being driven from line shafting, the power for driving being derived from a 7½-inch horsepower electric motor supplied by the Richmond Electric Company.

PUMPING SYSTEM.

The pumping system of an oil ship is necessarily a very im-

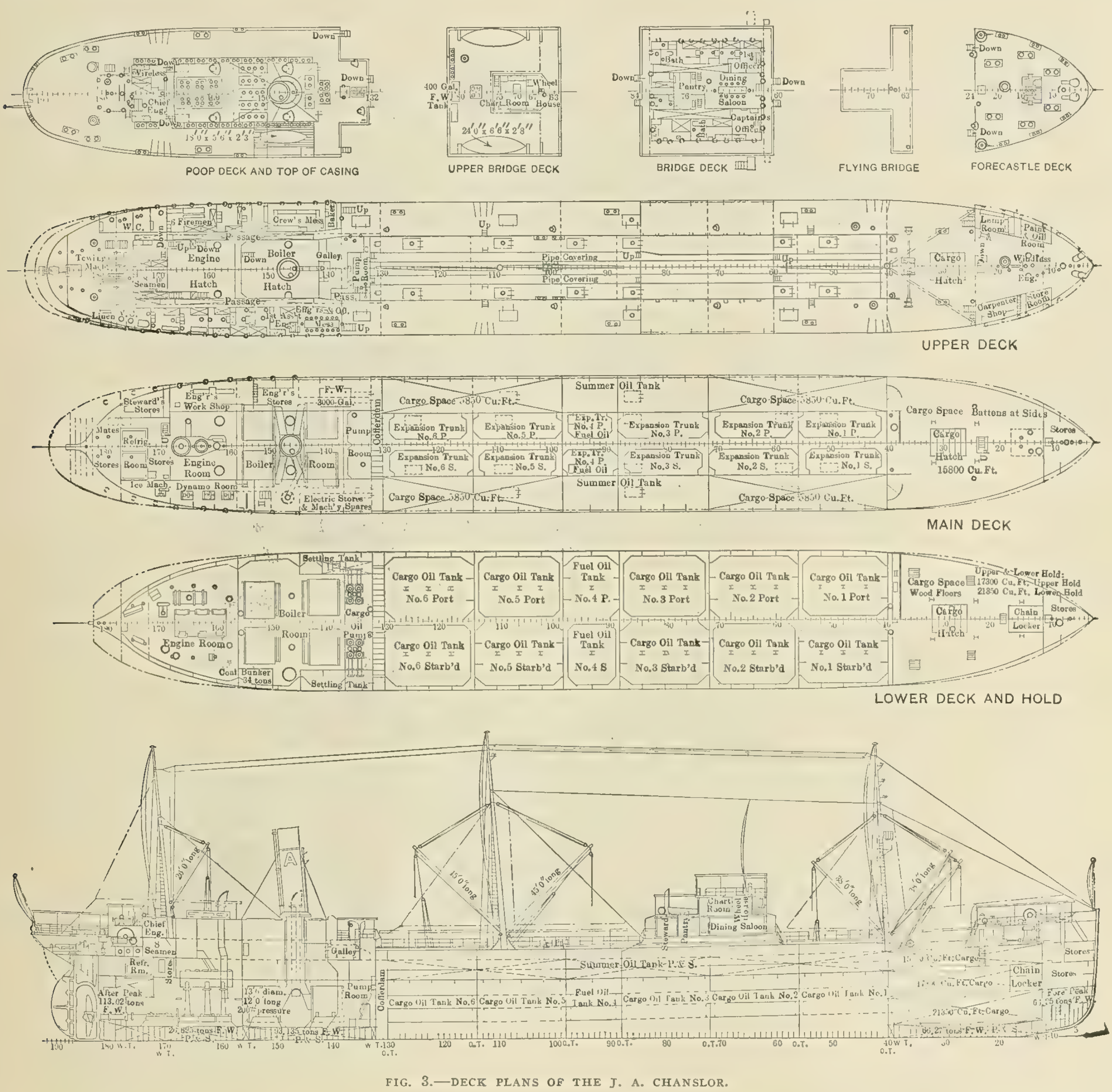


FIG. 3.—DECK PLANS OF THE J. A. CHANSLOR.

There is also a Providence towing machine of the Shaw-Spiegle type, 16 inches by 16 inches, for handling 1,800 feet of 2-inch diameter towing hawser. The winches, windlass, capstans and steering gear were all furnished by the Hyde Windlass Company, and the towing machine by Williamson Brothers Company.

Among special features not generally fitted on cargo steamers, but which are fitted on the *Chanslor,* are wireless telegraphy, installed by the United Wireless Company, a Nicholson ship log, telephone system between pilot house and engine room, Welin quadrant davits for handling the life

portant feature. That of the *Chanslor* is very elaborate. For the cargo oil system there are two Dow horizontal, duplex outside-packed plunger pumps, 16 inches by 14 inches by 18 inches, and for the ballast system one similar pump, 12 inches by 10 inches by 12 inches. The cargo oil suction system consists of a 12-inch main on each side of the vessel, with 10-inch branches to each cargo tank and 6-inch branches to each settling tank. A separate 6-inch suction is fitted to each fuel oil tank, and a 6-inch equalizing valve is also fitted in the center-line bulkhead between each pair of oil tanks. Each cargo pump is arranged to discharge separately or in combination into an

8-inch discharge belt main, which runs along the top of the expansion trunk, the two lines being connected at the forward end with a valve between. This main discharge extends on both sides to the after end of the poop and has 8-inch branches at three different points for connection to the discharge hose. Six-inch branches are also taken out of the main for discharging back into each tank. The discharge is so arranged that either pump can discharge into one side of the main or the other, and division valves are fitted so that one pump can work at a heavier pressure than the other.

The discharge system is so arranged that it may be used as a suction of either or both pumps. By-pass arrangements the sea also, and to discharge overboard, to all oil tanks on deck or to the fire main.

On the lower deck forward of the oil tanks is located a Dow horizontal duplex, piston type pump, 5¼ inches by 4¾ inches by 5 inches, with suctions from the sea, the fore peak, the forward double bottoms and forward hold, and discharging overboard and into the fire main.

The after cofferdam is arranged for flooding from the sea, and it, together with the pump room, bilges in fire and engine rooms, after peak, and after double bottom tanks, are drained through a manifold in the engine-room to which the donkey pump and the engine bilge pump are connected.

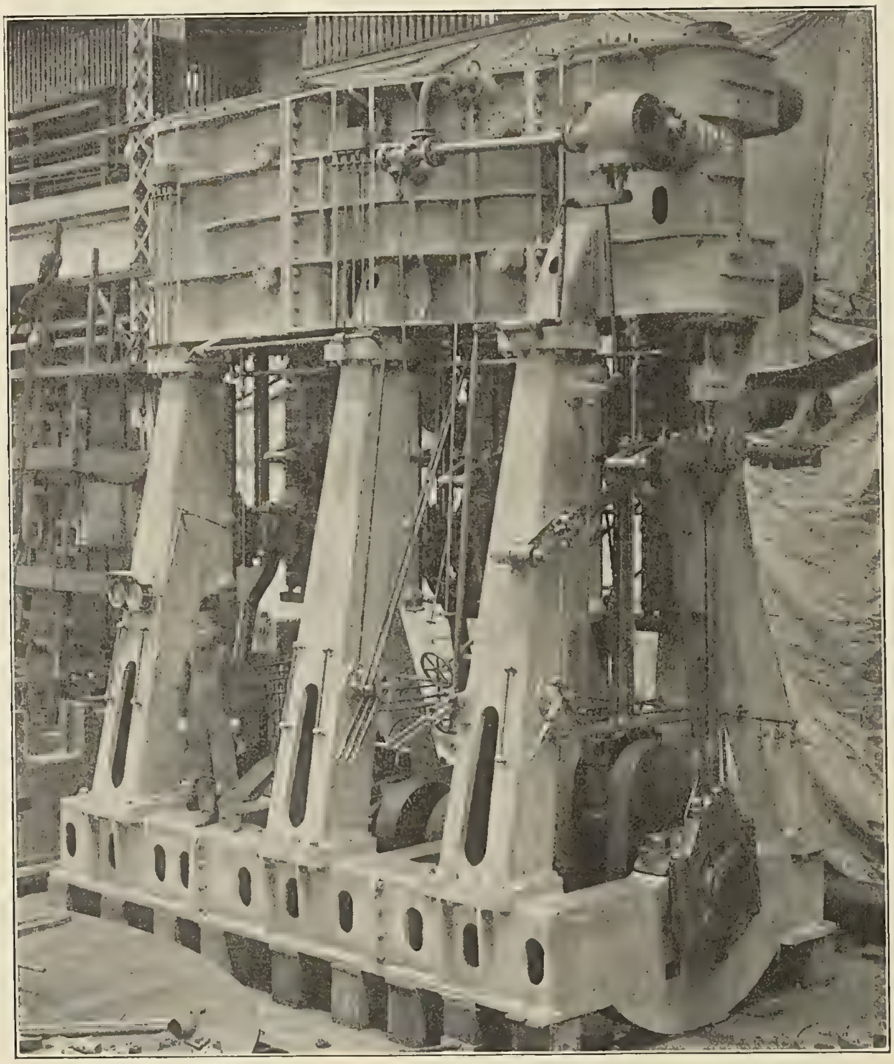


FIG. 4.—THE CHANSLOR IS PROPELLED BY ONE THREE-CYLINDER, TRIPLE-EXPANSION ENGINE.

are provided so that any tank on one side of the ship can be emptied and discharged into any tank on the opposite side, overboard, or through the suction system. All oil piping is standard black-wrought steel pipe with cast iron screwed flanges, and the valves are Crane cast iron gate valves. The suction system was tested to 125 pounds pressure, and the discharge system to 250 pounds pressure. Each oil tank is fitted with a 2½-inch air pipe lead into the masts.

A No. 3 Monogram Sturtevant electric exhauster is provided for drawing the gases from the oil tanks through the suction system and for ventilating the pump room. The motor for this fan is located in a special motor room, the fan being located on an extension shaft above the pump room.

There is a separate water ballast system with 8 inches suction to each tank, the ballast pump being arranged to draw from

PROPELLING MACHINERY.

As before stated, the propelling machinery is located in the stern of the vessel. It consists of one three-cylinder, triple-expansion engine, four main boilers of the Scotch type, and one vertical donkey boiler. The cylinders are 24½ inches, 40 inches and 68 inches diameter, respectively, with a common stroke of 48 inches, and are arranged in the usual order with the high pressure forward. A separate liner is fitted in the high-pressure cylinder. Piston valves are fitted on the high-pressure and medium-pressure cylinders and a double-ported slide valve on the low-pressure, the medium-pressure and low-pressure valves having balance cylinders. All valves are worked by Stephenson double-bar link motion. Steam reversing gear of the direct-acting type with a steam cylinder, 14 inches by 20 inches, is fitted on the back of the engine. All

pistons are cast iron of box section, fitted with bull and snap rings. Tucker's metallic packing is fitted to all piston rods and valve stems. An Aspinall governor is fitted to the main engines.

The piston rods are steel, secured to the pistons and cross-heads in the usual manner, with taper end and nuts. The cross-heads are of forged steel, with double cast iron slippers, having white metal wearing surface. The connecting rods are forged steel, 9 feet between centers, forked at the upper end to suit the cross-head, with gudgeon and crank pin boxes of cast steel lined with white metal.

The crankshaft is 14⅜ inches diameter, built up with steel shafts and pins and cast steel webs, and is made in two sections. The sequence of cranks is high-pressure, medium-pressure and low-pressure.

The bedplate is cast iron of box section, made in three sections with six main bearings. The main bearings are cast steel, lined with white metal, the bottom half being provided with water circulation. The housings are cast iron of box section, those in the rear being of the inverted Y-type. Separate cross-head guides, with water circulation, are fitted on both front and back housings. A steam turning engine, with single 8-inch by 6-inch cylinder, is fitted on the after port housing.

The thrust bearing is of the horseshoe type, having bearings at each end and fitted with 12 cast iron shoes provided with water circulation. The thrust shaft is 14⅜ inches diameter, and the propeller shaft is 14⅞ inches diameter, fitted with a composition sleeve the full length of the stern tube. Long composition bearings, lined with lignum vitæ, are fitted at each end of the stern tube.

The propeller is a four-bladed sectional one, with cast iron hub and manganese bronze blades. It is 17 feet diameter, with 17 feet pitch, and a developed blade area of 103 square feet.

AUXILIARY MACHINERY.

The condenser and all auxiliaries are independent of the main engine. The condenser has a cast iron cylindrical shell, with composition tube plates and ¾-inch Admiralty metal tubes, which give a cooling surface of 3,594 square feet. Water is circulated through the condenser by means of a centrifugal pump of the Newport News Shipbuilding & Dry Dock Company's own make. It has a cast iron shell and composition runner, has 12-inch suction and discharge and is driven by a 8-inch by 10-inch single cylinder vertical slide valve engine. The main air pump is a vertical twin beam, single-acting Blake & Knowles pump, 9 inches by 20 inches by 12 inches. For port use there is also an auxiliary air pump, 7½ inches by 14 inches by 10 inches, of the Simplex, double-acting, featherweight type, supplied by the Blake & Knowles Steam Pump Works. All other steam pumps were supplied by the George E. Dow Pumping Engine Company, of San Francisco, the engine-room pumps comprising the following:

Two main-feed pumps, horizontal, duplex, outside-packed plunger type, 10 inches by 6 inches by 10 inches.

One donkey boiler feed, horizontal, duplex, outside-packed plunger type, 7½ inches by 3½ inches by 6 inches.

One fire and bilge pump, horizontal, duplex, piston type, 10 inches by 6 inches by 10 inches.

One engine bilge pump, horizontal, duplex, piston type, 6 inches by 5 inches by 6 inches.

One fresh-water pump, horizontal, duplex, piston type, 6 inches by 4 inches by 6 inches.

One sanitary pump, horizontal, duplex, piston type, 6 inches by 4 inches by 6 inches.

Two evaporator feed pumps, horizontal, duplex, piston type, 4¼ inches by 2¾ inches by 4 inches.

Other engine-room features consist of a Reilly multi-coil feed heater of the closed type, and a Railton-Campbell grease extractor. There is also an evaporating and distilling plant, consisting of one 20-ton and one 12-ton Reilly evaporators and a 2,000-gallon distiller.

The boiler plant is of very liberal proportions, there being four main boilers, each 13 feet 6 inches diameter by 12 feet long, built for a working steam pressure of 200 pounds. Each boiler has three 41-inch Morison corrugated furnaces, with separate combustion chambers, and has 263 3-inch tubes, giving a total heating surface of 8,320 square feet. Each main boiler has a steam drum 36 inches diameter by 6 feet long.

The donkey boiler is a vertical one, 5 feet in diameter by 10 feet high, with a submerged head. It has 169 2-inch tubes, 435 square feet of heating surface, 14.25 square feet of grate surface, and was designed for a working steam pressure of 160 pounds.

The boiler plant is arranged for using fuel oil with steam atomization. Each furnace is fitted with a Staples & Pfeiffer automatic, superheating, self-cleaning oil gas burner, the oil being supplied by two 6-inch by 4-inch by 6-inch Dow horizontal duplex pumps, which discharge through special fuel oil heaters. Steam coils are also fitted for heating the oil in the settling tanks.

In the building of the *Chanslor* a good record for this type of vessel was made, it having been finished in ten months from the awarding of the contract. The contract was awarded June 20, 1909, the first keel plate laid August 3, the vessel launched February 12, the trial trip made March 16, and the vessel sailed for San Francisco on March 24, having previously taken on sufficient oil fuel, water and stores to take her to San Francisco without stopping at any intermediate port.

On her trial trip, in ballast condition, the vessel averaged slightly over 12½ knots on a measured mile course, the machinery indicating 3,000 indicated horsepower. The speed in service will be about 11 knots.

One of the latest additions to the German Imperial navy is a 30-knot, 650-ton destroyer, equipped with Zoelly turbines. There are two main turbines, developing 7,500 horsepower each at 650 revolutions per minute. Although designed for a speed of 30 knots, the maximum speed attained was 33 1/3 knots, while the average for a three hours' full speed trial was nearly 32 knots. The data from the trial trip are reported to be as follows: Steam pressure at the turbine, 14.85 atmospheres; vacuum, 89.95 percent; revolutions per minute, 643.9; slip, 23.4 percent; average speed, 30.757 knots; steam consumption, 14.2 pounds. The exhaust from the auxiliaries was not passed into the low-pressure stages of the turbines. Had this been done the foregoing results, in comparison with figures from other official trials, would have been considerably modified.

The destroyer has a length of about 350 feet, and it is reported that the turbines ran smoothly during all the trials, both in the workshop and since being fitted in the destroyer.

The Bureau of Navigation reports that ninety-two sail and steam vessels of 29,125 gross tons were built in the United States and officially numbered during the month of April, 1910. Six steel steamships, aggregating 12,314 gross tons, were built on the Atlantic and Gulf coasts, and three steel steamships, aggregating 12,839 gross tons, were built on the Great Lakes.

The Marine Engineers' Beneficial Association No. 33, of New York, held its fifteenth annual banquet on the evening of May 5. It was by far the most successful meeting that the organization has ever held, not only in numbers but in good fellowship.

FUEL OIL.—III.

BY E. N. PERCY.

There are five broad systems of burning fuel oil and residuum. First, atomizing the oil by means of steam or air. This is done with low-pressure air at 8 or 10 ounces pressure, second, by high-pressure air or steam at 20 to 150 pounds. Second, atomizing by oil pressure alone; there being several systems in the experimental stage. Some depend upon the centrifugal action of a special sprayer, some the impact of one jet on another, and others by the impact of the jet on a specially prepared and shaped surface. Irrespective of their merits, these systems have never come into general use, and, so far as observed, tend to carbonize heavily unless all conditions are just right and very delicate adjustments made. Third, spraying with mechanical atomization. Formerly this was used with great success, but it has been completely supplanted by blast atomization. Fourth, by heating oil in red or white hot retorts or pipes, or in a coke fire, with or without steam; thus really making a gas. This process is absolutely impractical for marine purposes, but has a wide and growing field elsewhere. Fifth, by burning in shallow trough-like grate bars. This method is used a great deal in Russia for boilers, also in steel works in this country; but it is only successful with oils of a certain gravity, heavy enough to be safe and light enough to burn in this way; but it is obviously impractical for a ship in a heavy seaway.

For practical marine work we are limited to the atomization method by air or steam. If low-pressure air be used, engine-driven blowers must be installed. If high-pressure air, engine-driven compressors are needed. If steam be used, evaporators must be provided to make up at least 1.5 percent of the total steam made in addition to ordinary losses; this representing the steam used by an average oil fire. Steam gives a longer, cooler flame, that burns with the same efficiency as air, and is not so hard on the brickwork and boiler but, obviously, takes too much water for a ship making long voyages. The marine boiler, therefore, is practically confined to the air atomizing system of using oil fuel, of either the high-pressure or low-pressure type, and we will consider these only, as steam burners do not differ materially.

Before taking up the burners in detail some of the main principles will be reviewed as established by actual practice. In the first place, it makes very little difference what burner is used, provided a fair atomization is obtained; much more depending upon the arrangement and experience of installers. (See report of naval board upon oil fuel.) In the second place, the most important thing is to obtain perfect mixing of sprayed oil and draft. In the third place, while almost any burner will work, as stated, under conditions of heavy fire, hot furnace and constant duty, there are many other conditions to meet in which the type of burner plays a very important part. Burners of any kind are divided into two great classes—inside mixing and outside mixing. The former mix the air and oil inside into a sort of lather, which is ejected in a more or less fine spray; the latter eject the oil and air separately, and they meet outside, and the oil is atomized by the impact and expansion of the air jet. There is very little choice; it is probable that most inside mixing burners can be adjusted to a smaller flame, more easily suspended in a cold furnace; while it is probable that the outside mixing burners will carry the largest fires and clog the least, and are the best for heavy service. The writer, personally, recommends one of each in each furnace, thus making it possible to meet all conditions, as no heavy-duty burner, so far as known, will work well with a very small flame; for instance, to keep the bricks hot when standing by.

The ordinary outside mixing burner does not differ materially from an ordinary perfume atomizer. It will be anywhere from 6 inches to 2 feet long, and may be exactly like an atomizer or it may have a central adjusting needle or cleaning wire, or the whole central piece may be removable for cleaning. It may be rifled at the point to make a rotary flame, or have a slotted point to make a flat flame. Some burners are both inside and outside mixing. Some are very elaborate, with adjusting needles, removable centers, contrivances to change the shape of the flame, etc.; but the tendency now is to simplify burners in favor of the central control system. Some people go to the opposite extreme, and use merely a piece of pipe for a burner, with nothing but a tee on the back to receive oil and air. Such a burner works all right under load, but is very cranky to regulate. The writer favors an open oil system, with two burners to each furnace, one an inside mixing type adjusted to hold a small flame, and the other as simple as possible for heavy work, and with no complications except a simple tee valve shut-off for each burner and central control. The small burners to be on a separate line and controlled separately, so that the small flames can be controlled for standby, to keep the bricks hot, yet keep the safety valve from popping.

The draft is an important point. It should be distributed all over the flame, coming from the grate bars preferably, especially with a flat flame; but a round or conical flame should take some air all around the burner, but not all here, else the flame will be too hot near the front, with the heavy draft and intense combustion near the burner. The amount of draft is just right when the stack smokes just a trifle, barely enough to see, as then there is no excess of air, and it is better to have the heavy smoke than to have a great air excess, since the excess air carries much of the heat up the chimney. Another way of telling if the draft is right is by the color of the flame tip. If it is a bright pink it is all right, but if a clear white there is too much air, and if smoky too little.

There are so many burners that instead of reviewing them the principles will be gone over and then a type of each described. The combustion of oil consists, first, of atomization, next, vaporation of each minute particle of oil by the heat of the flame, or reflected heat of the hot brick; next, the combustion of the vapor, and last, the combustion of the minute particle of coke. If there is not enough air this coke is not consumed, and it appears in the form of black smoke at the stack. If still less air is admitted, unburned vapors, tars and steam appear at the stack in the form of heavy brown and white smoke of very dense character. If no air is admitted, and the oil keeps spraying on the hot brickwork, as sometimes happens by accident, dense vapors of a steam-like appearance come through the stack. If, now, the air be turned on, without turning off the oil, an explosion takes place, known as a "back fire," and the flame will roar out into the fire-room, but seldom does any damage unless something inflammable or a person is directly in front. The draft is distributed as much as possible, part going in around the burner and the rest at all points under the bars. It is regulated by a shutter around the burner and the ash-pit doors or their equivalent. A quiet draft, quiet fire and enforced combustion should be the conditions for average marine boilers. Forced draft, admitted only around the burner, and strong atomization produce intense combustion, high temperature, much localized conditions which are not wanted in marine work.

Fuel oil will, on the slightest excuse, drop carbon and asphalt; the principal cause of this being overheating, say to 400 degrees F. or more. Experiment has shown that any burner which preheats the oil by direct application of fire is impractical on account of rapid carbonizing, hence this feature will not be discussed. Heating the steam or air by running a loop into the furnace is practiced a good deal with good results, but is wholly unnecessary. If carried to excess the

atoms of oil will be over-vaporized and will "star"; that is, the flame will appear exactly as though pieces of iron were burning in it, and much carbon will be thrown down and not burned. Right here a word of caution should be sounded to all experimenters, to the effect that there is no economy, theoretically, in adding heat to either air, steam or oil, except to make the oil flow more easily, and practice has condemned as a failure all burners that preheat the oil to vaporization in any way, as the apparatus promptly carbonizes.

Dangerous flare backs are due entirely to oil leaking into the hot furnace, and vaporizing, then suddenly taking fire. They usually occur from imperfect atomization, due, in turn, often to carbon or asphalt on the end of the burner. The only danger of a flare back is setting fire to something, or personal injury, and the remedy is to shut the oil off and put the burners in proper condition. Flashing or puffing is due to a construction of burner that permits a few drops of oil to collect in some fitting or pocket within the tip, and being blown out periodically, imperfectly atomized. Very bad cases will cause flare backs.

Starting an oil fire in a cold furnace is very easy with a good burner. In large plants, the steam or air comes from a coal-fired donkey boiler. In small harbor plants there must be provision to burn both coal and oil. The writer has often thought of a system including a small tank on deck to operate a small Koerting pressure burner by gravity for starting purposes, but has never seen it tried out. A burner that atomizes well will hold a suspended flame in a cold furnace if the lighter fuel oils are used, but no kind of a burner will hold a suspended flame with very heavy unheated oils, and no ordinary fuel oil can be lighted and burned in suspension if a rough burner that does not atomize finely is used. In such cases a coal or wood fire will be used and the oil sprayed directly into it. Whenever there is difficulty in firing up a heavy plant, or if one is in a hurry, it is a good plan to start a good coal fire in each furnace, and then the burners may be turned on as heavily as wished, remembering, of course, that oil can be forced much more than coal, and if overdone with a cold boiler, particularly of the Scotch type, will set all the tubes to leaking.

Most installations provide a target of firebrick, either built up of loose, broken pieces of the flame to impinge on, to steady the heat and to insure combustion in case the flame does not suspend. The best recent practice eliminates the target, but surrounds the flame with white hot brickwork and provides a burner that will suspend at all times under all conditions, except with cold oil of a gravity that cannot be atomized. The hardest thing for the novice to get is the suspended flame. He will make the oil burn by impact on hot brick or burning coal, but it takes some skill and adjustment to get a clear flame suspended from the burner in a cold furnace. It depends upon perfect atomization, not too much air or steam, not too much oil, and carefully regulated draft. Once the furnace is hot the flame will suspend under almost any conditions if the installation is right.

The tip of the flame is the point of maximum temperature, and, because of fuel and blast, is hotter than a coal fire and must not be allowed to impinge on any part of the boiler or brickwork, as it will quickly destroy either. It must not be long enough to reach the tubes, as combustion ceases there and unburned products are wasted in the chimney gases in the form of unburned coke and hydro-carbons.

The length of the flame depends upon the pressures employed and the draft distribution. The shape of the flame depends upon the burner used. The conical flame is the least economical, because the air does not easily reach the interior. Experienced experts are of late adopting various forms of flat flames spread completely over the grate bars or source of draft. Most of the draft is admitted through large areas and distributed gently on the under side of the flame, with a very little, if any, admission over the flame. Conical, barrel, whirling and similar flames are now mostly replaced by flat flames, even in Scotch furnaces; actual tests being in favor of the latter. The most important feature in the shape of the flame is that the air shall reach all parts without there being an excess. All boiler flames are more or less limited in length, compelling a somewhat intense combustion and very little volume or time for mixing air and oil, and with flames of large body filling the furnace it is not possible to get complete combustion without great excess of air. Recent flat-flame burners, made to the order of an oil expert, developed full power with 12 percent excess air and less than 1 percent steam consumption. Relative to the draft, it is proper to state that for every 100 percent excess of air will be burned 10 percent additional fuel.

The various burners have the following parts and functions:

First, and most important, regulation of the air or steam pressure. This is most important and is usually accomplished by an ordinary globe valve at each burner, or a central globe valve for central control systems. It is not used to control the flame, but is a necessary adjunct of the adjustment for atomization. The spray needle running to the orifice is almost abandoned now as a method of adjustment, but many burners have a wire that is meant for cleaning purposes only. The proportion of the orifices, etc., is purely a matter of experience, but in general, it may be said that the oil port is of minor importance, but the shape and size of the final issuing hole or slot is the making of the whole burner. It shapes the flame, determines the capacity, and is the important part of all.

The fire is regulated by regulating the oil. On single burners, or old style installations, a double connection is provided that shuts off both the oil and air with one lever, but late practice embodies central control of the oil pressure, with attachments to each furnace for adjustment only, or the cutting out of a boiler. The flame may be horizontal, vertical, or at an angle. It may be shot from the front in, as in a Scotch boiler, or from the back forward, as in a locomotive type, or from above down, as in a Babcock & Wilcox boiler, or from the bottom up, as in a Thornycroft.

The test points and characteristics of a good, oil-burning plant include ease of starting with cold furnaces. This is the hardest test on the really fine points of a burner, and is the situation in which the difference between a burner and two pieces of pipe show up. It must carry a suspended flame. It is a poor installation that depends on a target or bed of coal to keep the oil burning. One expert scorns to use lighted waste, but simply lights his burners with a match or candle, and the writer has seen them burn in a cold furnace with a flame only 12 inches long, which could instantly be lengthened out to as many feet. The plant must give a small flame without going out, and it must endure all possible regulation from central control without going out. It must not be too sensitive, which is a fault of most burners that atomize at high pressures. It must not throw down carbon, which is a fault of most burners when crowded, particularly with large, solid flames, and is due to the air not reaching all parts of the flame. It must not smoke, nor must it require more than 25 percent excess of air, and it is possible to run with 10 percent excess. There should be a low stack temperature with any rational boiler installation. Excessive heat should not be radiated through the front of the furnace into the fire room.

The flame must not star, which is due entirely to overheating either the air, steam, oil, or a long, hot burner. Let it be emphasized here again that the mistake most novices have to be educated out of by hard experience is the applica-

tion of too much heat to the oil before combustion. It always makes trouble and burns no better; in fact, will throw down carbon instead. The flame must not impinge on the boiler parts anywhere, and preferably not on the brickwork. The sides of the flame do no harm, but it must not strike directly. It should burn quietly. The principal cause of noise is high pressure and imperfect atomization. It is possible to get perfectly quiet combustion, except in furnaces that are small for the work, but it takes careful adjustment and first class installation.

A good burner will not flash back, because it will burn all oil in suspension and will not drip any. It does not sputter. Sputtering is caused by moisture in the oil, or wet steam, or both; but in a correct installation the oil is separated from the water, and the steam is dry.

Most oil-burning installations involve the making over of coal-burning furnaces. If experts are not available there is no reason to hesitate to make such an installation. In such a case the first thing is the target. It is preferably of loose pieces of broken brick for the oil to impinge against. It is not necessary where a high-grade installation is made, but should always be used where the installers are not thoroughly familiar with oil fuel. The brickwork should surround the flame and keep it from impinging on the boiler; at the same time, too much heating surface must not be covered. The draft should be distributed as much as possible over the flame, and so arranged that it cannot pass the furnace without going through the flame. It may be preheated by passing through hot grate bars, or heated ducts under the brick, but it does not pay to make any heavy investment to preheat the draft air, since extremely high temperatures are not wanted in boiler furnaces, and preheating is not a factor of economy if the installation be correct, unless the air be preheated with waste heat, as in the Howden system, which has never been tried yet with oil, since oil fires without blowers can be forced beyond the boiler capacity, but undoubtedly economy would result. The shape of flame should be such that no air can pass around it, and yet all parts of it can be accessible to fresh air. The length does not matter, so long as it does not impinge on the boiler, and so long as all the fuel is properly consumed.

Many installations require that the change to coal burning shall be made with ease. This is a matter of mechanical judgment, and does not require expert knowledge. Usually, the grate bars are left in place in this case, and are merely protected with a layer of brick.

In designing for oil exclusively, as with a new boiler, a stack slightly smaller than that for coal will answer. The following evaporations may safely be counted on per square foot of heating surface:

Scotch, 5 pounds of water per hour from and at 212 degrees Fahrenheit.

Hohenstein, 6 to 14 pounds (according to draft).

Babcock & Wilcox, 4 to 7 pounds.

Stirling, 4 to 7 pounds.

Plain cylindrical, with small tubes, 5 to 5.5 pounds.

The first figures give the conservative ratings for all boilers, and the second the maximum safe limits. No high limit is given for the Scotch, since they are designed usually to operate at pretty high rates of evaporation, and any pushing is apt to bring down the crown sheets, especially as 5 pounds is rather high, but if the circulation is known to be good and the furnace sheets are clean the boiler may be forced to do as high as double duty, but the furnace sheets should be watched every minute to see the color, and they should not be allowed to glow at all, nor even to scale, which can always be ascertained by the sparks from the scale as it drops into the fire, which, however, must not be confused with starring. Starring consists of millions of sparks, while scale makes just a few, where the bits of scale drop from the top of the furnace into the fire.

The heating surface per horsepower should be proportioned to the evaporation, and not taken at any rough commercial rating. With Scotch boilers and triple expansion engines of modern design, and say 150 pounds pressure, it is customary to allow 3 square feet of heating surface to the engine horsepower, but this includes auxiliaries, port duty and all, and is a rough commercial rating only.

As to the amount of oil used, it is almost impossible to compare it to coal, as the calorific value of coal varies from 9,000 B.T.U. per pound to 14,000; besides, it is impossible to burn some coals efficiently because of caking and clinkering, and there is always a loss due to cleaning fires, while oil runs uniformly at 18,000 heat units, and burns with uniform efficiency. However, it has been found that three barrels of oil are equal to 1 ton (2,000 pounds) of the poorest Western coal, 4 barrels of oil are equal to one ton (2,000 pounds) of the best Eastern coal. The following actual boiler efficiencies have been made by test:

Type of Boiler.	Efficiency with Coal, Anthracite, Percent.	Efficiency with Oil, Percent.
Plain cylindrical	71.3	74.7
Hohenstein natural draft.	64.4	65.6
Forced draft	59.5	56.7
Scotch	78	82
Babcock & Wilcox......	..	83, at 3.85 pounds evaporation. 74, at 7.1 pounds evaporation.

To operate the burners takes from 1 percent or less to 4 percent, and even more of the steam generated, depending upon the grade and character of installation. If compressed air be used, from 30 to 100 cubic feet per pound of oil are required, depending upon the system used. It is more correct to give it in terms of power, and still more correct in terms of heat units via compressor, etc. By steam, direct, it may be taken as 1 to 4 percent. By air, the heat units can be reduced to a negligible amount, particularly if the compressor be attached to the main engine, or otherwise economically operated, but less than 1 percent is always obtainable, particularly with modern low-pressure systems.

The evaporation per pound of fuel, from actual tests, is as follows:

Type of Boiler.	Pounds of Water.
Scotch	14
Plain cylindrical	14.75
Locomotive	13.25
Hohenstein	13.8
Babcock & Wilcox	15.85, at 4 pounds evaporation. 14.1, at 7 pounds evaporation.
Stirling	13.8

The furnace should allow for a flame length of at least 8 feet, and more if possible.

In making oil fuel computations, the following data will be of use:

One gallon of oil equals 8 pounds; 1 pound of oil equals 18,000 heat units; 1 barrel of oil equals 42 gallons; 1 barrel of oil equals 336 pounds; weight of oil equals 60 percent weight of coal; storage space for oil is 56 percent that for coal; 100 barrels of oil equal 560 cubic feet.

Scotch boilers are usually arranged for fuel oil by removing the grate bars, and lining the lower half of the furnace with firebrick. Across this, at right angles, are placed two dams of checkerwork, or broken pieces of brick. The flame is pitched downward and passes through the checkerwork, and while radiating its heat to the top of the furnace does not impinge upon it. The entire combustion chamber is lined, until recently, since suspended flames have been so perfected the practice is being gradually abandoned.

Plain cylindrical boilers are fired by protecting with brickwork, and shooting the flame on a target placed at about the bridge wall, and covering the grate bars with brick. If the boiler is designed from the first for oil the burner is placed at the back of the furnace, and the fire is carried in a long, white-hot tunnel, and the ingoing air is preheated in brick ducts

under the furnace; a practice of doubtful value. At the end of the tunnel, near the furnace front, the flames reverse and pass under the boiler proper.

Locomotive type boilers are fired from the back and bricked half-way up to protect the water legs and make radiation surface around the flame.

Babcock & Wilcox and other watertube boilers are fired in many ways, but, in general, the grate bars are removed, the flame is flat and shoots in any direction so long as it does not impinge on parts of the boiler, and the draft is evenly distributed so that it all has to pass through the flame.

THE NORTH LAND.

On April 5, 1910, the Maine Steamship Company placed a fine new steamer on the route between New York and Portland, Me. This new vessel, which is a handsomely modeled, compactly arranged and well ventilated steamship, was designed and built by the Harlan & Hollingsworth Corporation, Wilmington, Del. She was completed in the short time of seven and one-half months from the date of laying the keel to the date of sailing on her first voyage. This is a good record for rapidity of construction, considering the many snow storms and the amount of bad weather experienced this last winter. The amount of joiner work to be erected can readily be estimated from the drawings and photographs published herewith.

The *North Land* is 330 feet over all, 47 feet molded beam, 28 feet depth to saloon deck, with a load draft of 17 feet. The decks below the saloon deck are the main and lower decks, and above the saloon deck the promenade and hurricane decks. The vessel is built of steel, with scantlings, to comply with the American Bureau of Shipping Rules; she is divided transversely by seven steel bulkheads, five of which are watertight, and a continuous cellular double bottom extends from the aft peak to the fore peak bulkhead. Athwartship wells are left in the double bottom in the engine room and at the end of the shaft alley. The tank top is made tight over these wells, and valves are fitted for bilge drainage to same, so that in the event of the bottom of the ship being punctured in the well space the safety of the vessel would not be endangered.

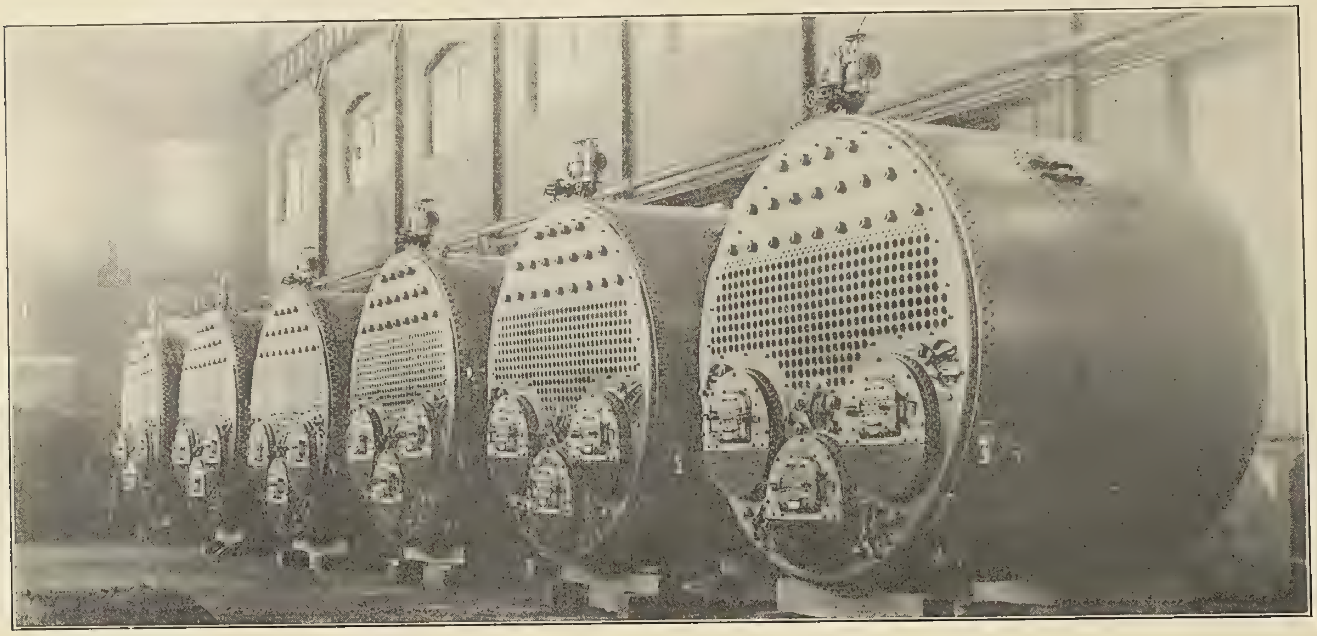
The main deck is entirely plated with steel, the lower and saloon decks are partially plated, while their ends are bound and tied by steel stringers and tie plates. The decks are supported by steel channel girders having wide-spaced steel pillars. The superstructure is entirely supported by steel, a steel bulwark extends around the saloon deck, terminating in a steel forecastle extending to the promenade deck. The bulwark is stiffened by channel stanchions, which extend to hurricane deck, carrying steel frieze plates at the promenade and hurricane decks. The customary turned wood rail stanchions have been dispensed with and steel substituted, thus giving the vessel a clean and neat appearance which has been commented on by many in New York and Portland. Freight is taken on board through two very large cargo ports on each side of the main deck level, from thence it is conveyed to the holds by two double elevators, operated by hoisting engines of Williamson Bros.' make. The vessel will carry a deadweight of 1,700 long tons, and as her stay in port is only twenty-four hours every facility is provided for the expeditious discharge and loading of cargo. Her bunker capacity is such that sufficient coal can be carried to make two round trips. Fresh-water tanks are provided for boiler feed and for galley and passengers' use.

The vessel has 180 staterooms in addition to those provided for officers, petty officers, wireless, etc. Seven of these are large bedrooms, having tastefully paneled walls, with built-in mirror panel, brass bedstead, etc. Twenty-nine of the larger staterooms are fitted with brass beds and arranged with communicating doors, so that they may be used en suite. One noticeable feature of the arrangement is that all staterooms—with exception of two—are entered from inside. The rooms which do not have outside windows are splendidly lighted and ventilated by skylights, which can be opened or closed from within.

NEW STEAMER NORTH LAND, BUILT BY HARLAN & HOLLINGSWORTH FOR THE MAINE STEAMSHIP COMPANY.

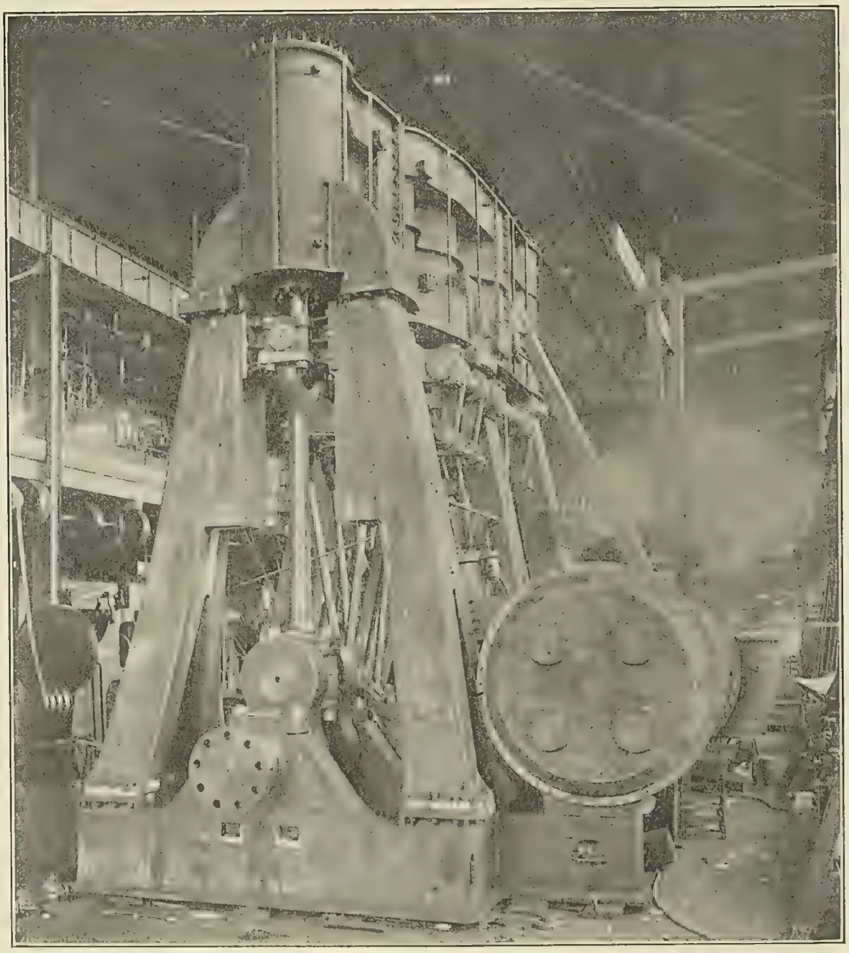
The builders have made a decided departure from the customary internal arrangement of coastwise vessels, where the staterooms are usually arranged around a large open saloon, curved parallel to the side of the house line. In the *North Land* ample sitting and lounging space has been obtained by substituting large hallways at each stair landing, and by a commodious social hall on the hurricane deck instead of the long, narrow curved saloons as heretofore. The passengers have already expressed their approval of this arrangement, as a splendid view can always be obtained in bad weather, which was not possible with the inside saloon.

The main hall or entrance on the saloon deck is a large space, the floor of which is covered with interlocking rubber



THE NORTH LAND'S MAIN BOILERS, ERECTED IN THE BUILDER'S SHOPS.

tile of a quiet design by the Pennsylvania Rubber Company. The newsstand is located in this hall. The dining saloon is on this deck, and has a seating capacity for 132 passengers; over the dining saloon is a central light and air well, lighted by a skylight on top of hurricane deck house. The paneled walls of this room are finished in ivory white with slight gilt relief, the furniture is of mahogany, the upholstery and carpet being of a dark red shade. The room is well lighted by ceiling fixtures, and the tables have adjustable silver electric lamps with red silk shades, all contributing to a very restful, warm



MAIN ENGINE AND CONDENSER OF THE NORTH LAND.

and pleasing effect. The pantry and galley are located directly abaft the dining saloon on the starboard side and the bar-room on the port side, with the chief steward's room abaft same. The galley and pantry are perfectly ventilated by outside windows and vertical shafts leading to the hurricane deck. It has been particularly noted that no smell of cooking was noticeable in either the dining saloon or the passenger quarters.

A large stairway leads from the dining saloon and from the after hall to the promenade deck landing in commodious halls, while over the former a stairway leads to the social hall on the hurricane deck. These stairways are of mahogany, neatly and substantially constructed. The newel posts and the steel pillars supporting the dining saloon well, being finished in the same style, are further ornamented by a wreath of electric lights. Balustrades, mirrors, rubber treads, brass plates and builders' name plates of very simple and tasteful design complete the finish of these stairways. The carpet of the promenade deck is of green shade, as is the upholstery in the lounging spaces, giving a restful effect.

The social hall, or music room, on the hurricane deck, is one of the features on the *North Land*. This is a commodious apartment, which can be reached from any part of the interior without necessitating—as is often the case—running the gauntlet of rain or wind across some exposed deck. In the center of this social hall is the well which lights the dining saloon. The piano and furniture of this room are of dark mahogany, the lounges, chairs, etc., are upholstered in red leather, and the floor is covered with carpet of a shade which harmonizes with the whole. The walls are paneled and finished in ivory white with gilded pilasters and caps. This apartment has doors on either side opening on to the hurricane deck, and at the fore end doors opening into the smoking room. This hall is lighted by two skylights and the side and end windows, from which a splendid view may be obtained.

The smoking room is an ideal spot, with a complete toilet room opening off same. The smoking room walls are paneled in stained oak, the seats are upholstered in dark green leather, the floor is covered with a mosaic tile inlaid linoleum imported from Germany, and used in this case for the first time on shipboard. This room has six card tables with linoleum tops and oak framing, and is lighted and ventilated by side and end windows and overhead skylight.

The officers' rooms and pilot house are located forward of the smoking room. Communication is maintained for emergency in bad weather by an interior stairway leading from the pilot house to the promenade deck. A toilet is fitted for the officers' use opening into the pilot house. The captain's room is handsomely finished in oak and is adjacent to the pilot house, opening into it. A house for wireless telegraph is located between the smoke funnels, and fitted with a Pullman bed for the operator. The carpeting and upholstery work on this vessel was done by the builders at their works.

The huricane or boat deck is used entirely for passenger promenade, except the small space which is occupied by boats, skylights and houses. Access to this deck is obtained from three points—one aft, one forward and through the social hall. The arrangement of toilets is very satisfactory, as every deck is provided with them, and all are centrally located, well equipped, lighted and ventilated, as can be seen on the plan. Three drinking wall fountains are fitted in convenient places, where ice-cooled drinking water may be had. The sanitary piping on the *North Land* is all of brass, while the bilge and ballast piping is of cast iron and lead.

The vessel is lighted by electricity, and has a powerful searchlight. The electric fixtures are neat and attractive, all being fitted with frosted bulbs. The running lights and compasses are also lighted by electricity, and a tell-tale apparatus is fitted in the pilot house.

The life-saving appliance consists of eight metallic lifeboats, four metallic rafts and a working boat. The boat davits are of a new type, in which the upper block is part of the davit itself. Seven hundred and twenty life preservers are stowed around and eight life-ring buoys. Fire outlets and hose are found on each deck, and are in excess of requirements. Communication between the pilot house and the engine-room is by means of a Corey telegraph; telegraphs are also used for docking the vessel. Speaking tubes and telephones are also fitted between important points in the vessel, and the usual electric bells and anunciators are in evidence.

The vessel has a steam steering gear of Williamson Bros.' make, also an independent hand-steering gear, a hand-screw gear aft and emergency relieving gear. The anchors are of the stockless type, stowing in the hawse pipes. The windlass is of the American Ship Windlass Company's make, and is also used for warping the ship. The steam warping capstan at the aft end has been supplied by the same company.

The propelling machinery consists of one set of triple-expansion engines, having cylinders 28½ inches, 46 inches, 75 inches diameter by 54-inch stroke. The working steam pressure is 180 pounds per square inch. The cylinders are supported, back and front, upon cast iron inverted "Y" columns. The crank shaft is of the built-up type, being in three interchangeable sections. The propeller is solid, having four blades, and is 16 feet diameter. The valve motion is of the ordinary Stephenson link type. The condenser is cylindrical, of steel plate and independent of the main engine framing; it contains 6,000 square feet of condensing surface. The air and bilge pumps are reciprocating, being worked from the cross-head of the main engine. All other pumps are independent.

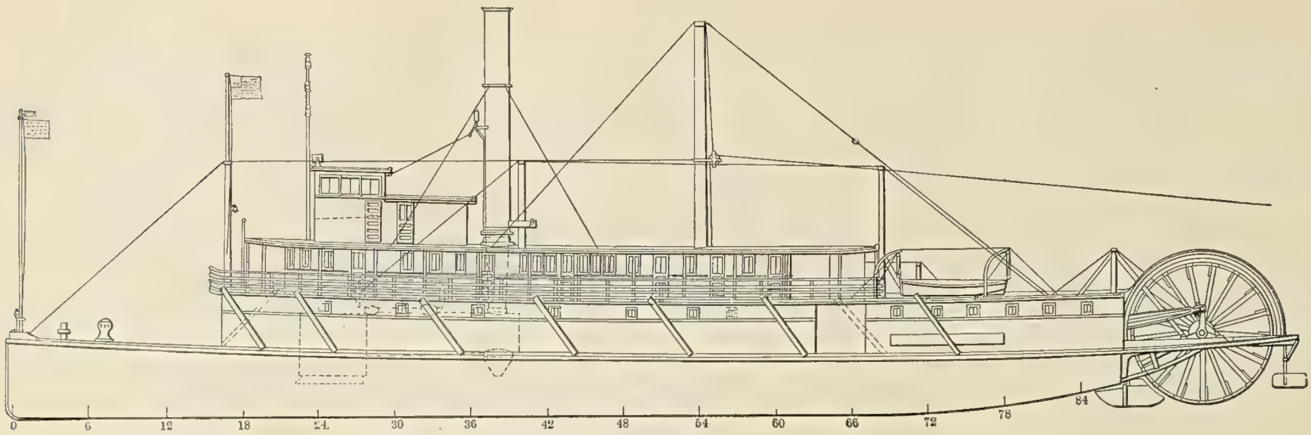
The main boilers, six in number, are of the cylindrical return tube type, 13 feet 8 inches diameter by 11 feet 6 inches long, each containing three furnaces. The total heating surface is 13,692 square feet, and the total grate surface 390 square feet. There are two stacks, and special ventilation is provided in the fire-room, having, besides four large ventilators, a blower with distributed air outlets. A donkey boiler for auxiliary purposes, 9 feet diameter by 10 feet long, is located on the main deck. An ejector and special pump are provided for handling ashes.

A POWERFUL STERN WHEEL TOWBOAT.

The stern wheel towing steamer *Gamecock*, recently completed in Joseph Supple's Shipyard, at Portland, Oregon, for the Willamette & Columbia River Towing Company, deserves special mention as an example of the latest improved type of stern wheel steamboats designed for heavy towing.

Portland has a lumber output greater than that of any other city in the world. The cut last year amounted to 610,000,000 feet. All the raw materials for this large output come from logging camps scattered along the Columbia River and its tributaries, and the logs are towed in rafts to the mills on the Willamette River at Portland. The logging district extends from 10 miles below the mouth of the Willamette River to the bays at the mouth of the Columbia River, a distance of about 90 miles. The mills at Portland are located 12 miles up from the mouth of the Willamette River, so that the longest tows are a little over 100 miles, all up stream and against an average current of 3 miles per hour, which increases to over 5 miles per hour during flood stages. The *Gamecock* will handle from one million to two million feet of logs per trip, gaging her tow to meet the condition of the current. The rafts in a tow of large size are in three and four sections, each about 500 feet long. The tow line is usually run out about 1,000 feet, so that the aft end of the raft is over a half a mile from the stern of the towboat.

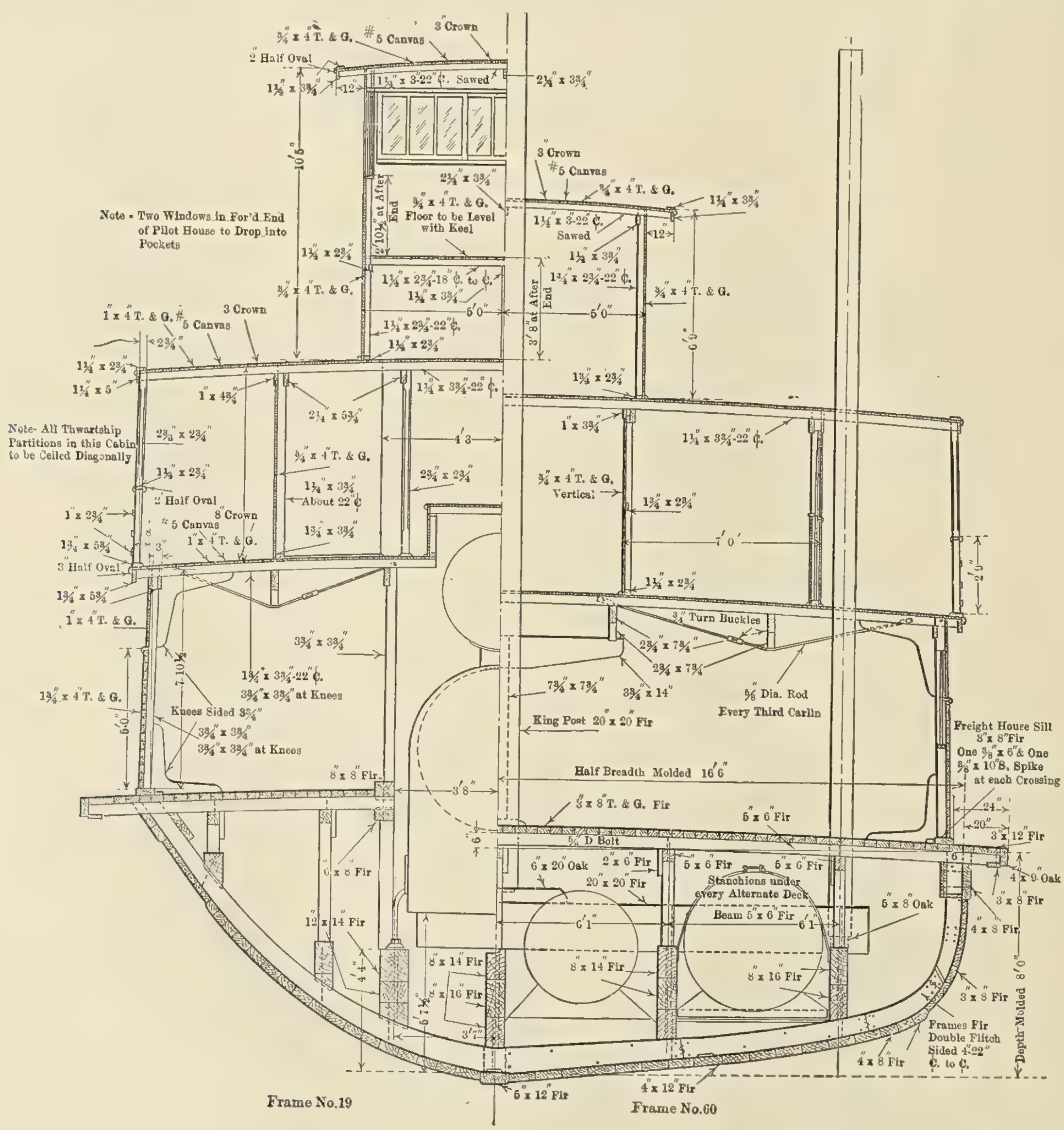
The Willamette & Columbia River Towing Company have



OUTBOARD PROFILE OF THE STERN-WHEEL TOWING STEAMER GAMECOCK.

been engaged in the log-towing business for over twenty-five years, and have several powerful boats in their fleet. In the *Gamecock* they have introduced all the features of improvement which their long experience suggests, and with them are combined the skill of her builder, gained by over twenty years' experience in constructing stern-wheel craft:

Length, 160 feet, with cylinder timbers extending 26 feet aft to fantail, making length over all..... 186 feet
Molded beam .... 33 feet
Molded depth .... 8 feet



CROSS SECTIONS OF THE GAMECOCK AT FRAMES 19 AND 60.

CONSTRUCTION DETAILS.

The stem is of oak, molded 16 inches, sided 12 inches, strongly reinforced by deadwood, and a natural crook apron. The frames are of Oregon fir 4 inches, double flitch, sawed to form, spaced 22 inches centers. The keel is of 5-inch by 12-inch fir, and the forefoot of oak. The transom is 4 inches thick; the bottom planks 3¾ inches thick; top side planks 2¾ inches thick. In the main keelson two strakes are of 8-inch by 14-inch fir, and one strake 8 inches by 16 inches. The outer keelsons are two in number, each of two strakes of 8-inch by 16-inch fir. The sister keelsons are two in number, each of three strakes of 8-inch by 14-inch fir. All timbers for keelsons are in not less than 50-foot lengths. The boiler keelsons are of two strakes of 12-inch by 20-inch fir 60 feet long.

The deck beams are of 5-inch by 6-inch fir to camber, increased to 5 inches by 8 inches and 5 inches by 12 inches forward and under the capstan. The sheer strake is in two pieces, each of 4-inch by 8-inch fir. The clamp is in two pieces, each of 3-inch by 8-inch fir. The knuckle strake is in three strakes, each of 4-inch by 8-inch fir. The main deck is of 3-inch by 6-inch tongued and grooved fir. The nosing is of 4-inch by 9-inch oak. The cylinder keelsons are of four strakes of 10-inch by 18-inch fir, 50 feet long. The forward buffalo is of 10-inch by 12-inch oak 12 feet long. Of the hog posts the forward king post is 12 inches by 12 inches by 32 feet long, the center king post is 20 inches by 20 inches by 50 feet long, the forward side posts are 10 inches by 10 inches by 32 feet long, the after side posts are 10 inches by 10 inches by 31 feet long, and the wheel posts are 8 inches by 8 inches by 14 feet long. All posts have heavy step timbers reaching athwart all keelson strakes, and the posts are stepped into oak plates. A very heavy system of hog rods, with turnbuckles in each section, extends over the various sets of posts, thus keeping fore and aft alinement perfect.

The center king post is set on the center line a few feet aft of the fore and after center, and carries a swinging block on the after side near the top, which guides the wire towline down to the towing engines on the main deck. These engines keep a constant strain on the line and take it in if the boat backs up. Placing the pull at this point enables the boat to be easily controlled by her rudders.

The guard overhangs 2 feet alongside and holds its width well up forward. At the waterline the hull is protected by a strake of galvanized iron sheathing, to prevent chafing against floating obstructions.

As the boat is not intended to carry passengers, provision is made for quarters for the crew only, consisting of a full freight house, containing machinery and accessories, with a half-cabin on the boiler deck and a pilot house and short texas on the hurricane deck. All are built of unusually strong framing, reinforced by natural crook knees. About 175,000 feet of lumber were required in the hull and houses.

PROPELLING MACHINERY.

The propelling machinery is unusually powerful, and capable of withstanding the most severe usage. The engines are direct-acting, of the usual stern wheel type, with cylinders of 18⅝ inches bore and 84 inches stroke, with counterbalanced slide valves. The shaft is of nickle steel 10 inches in diameter. The cylinder "timbers" are spiral rolled steel I-beams 15 inches deep by 6½-inch faces, weighing 80 pounds to the foot. The inner beams are 60 feet long and the outer 51½ feet long. The outer beams are bent in at the after ends and secured to the inner beams by steel brackets.

These beams and their settings are special features, designed to avoid trouble which has arisen from racking the engine settings. The I-beams are set on oak bases, which are notched over the deck beams in two parts—one above and one below the deck beams, clamping them firmly and holding them rigid by wedges. At intervals of 3½ feet iron lugs are riveted on to the lower faces of the I-beams. These lugs are set in sockets in the oak, cut wide enough to admit a wedge on each side of the lug. Thus, by wedging up all slack of the oak on deck beams, and by wedging taut the lugs in the oak bases, it is expected there will never be any fore-and-aft movement of the I-beams. This method of setting the cylinders is entirely novel, and considerable interest is taken in the result. The cylinders are secured through the I-beams and keelsons in the hold, with turnbuckle bolts in a very substantial manner.

The boiler is of the locomotive fire-box type, 76 inches diameter of shell, containing 217 tubes 2 inches by 18 feet, and is allowed 175 pounds steam pressure. It provides ample steam for the engines and accessories when doing the heaviest possible duty.

Crude oil is burned for fuel, and a supply is carried in six cylindrical steel tanks in the hold, having an aggregate capacity of 380 barrels. This large supply is necessary, as at times it takes five days to reach the tow and return with it.

The steering gear consists of four main rudders secured to the transom and two auxiliaries, or "monkey" rudders, attached to the fantail aft of the wheel. The pilot is aided by a steam steering gear of the "short gun" type.

The propelling wheel is 20 feet in diameter, with buckets 22 feet long by 30 inches wide, dipping from 30 to 36 inches, according to the trim of the hull. This extreme depth of dip is necessary on a boat which exerts its maximum power when producing only a very moderate forward motion.

The boat is completely equipped with electric lights, and has a searchlight of 3,000 candlepower.

In spite of her massive construction, the lines of her hull are graceful, and she shows good speed when running without a tow, and presents a pleasing appearance when in service.

When completed the *Gamecock* represents a value of $40,000 (£8,218), and is claimed to be the staunchest boat of her class in this port.

EFFECT OF SHIFTING CARGO.

BY ARTHUR R. LIDDELL.

The effect on the stability of a vessel of the removal of a weight from her center line towards one of her sides is, in a general way, well understood, but the extent of the loss of righting power which this represents is not always quite realized.

Assume that a steamer of 240 feet by 33 feet 6 inches by 19 feet has a *GM* height of 12 inches, with a homogeneous cargo of grain. In this condition she may have a curve of levers, as shown in Fig. 1, by the full line, which cuts the base at about 47 degrees.

Now, assume the cargo shifted, so that the center of gravity G is raised by the amount $GG_2 = 1$ inch further from the keel and moved by the amount $G_2G_1 = 2\frac{1}{4}$ inches to starboard to the position G_1 in Fig. 2.

For the angle of heel α the reduction in length of righting lever, due to the raising of G to the position G_2 is equal to $GG_2 \sin \alpha = 1 \sin \alpha$ in inches. The full upper line being the original curve of levers, as above observed, the corrected line for the raising of the center of gravity is shown dotted just below it. At 90 degrees the reduction of positive or increase of negative leverage equals 1 inch.

The lateral movement of G to G_1, represented by the line G_2G_1, reduces the lever by an amount equal to G_2K, which is equal to $G_2G_1 \cos \alpha = 2\frac{1}{4} \cos \alpha$ in inches, while at other points along the stroke-and-dot line the reduction of positive

or increase of negative leverage varies with the cosine of the angle, so that it becomes $2\frac{1}{4} \times 0 = 0$ at 90 degrees.

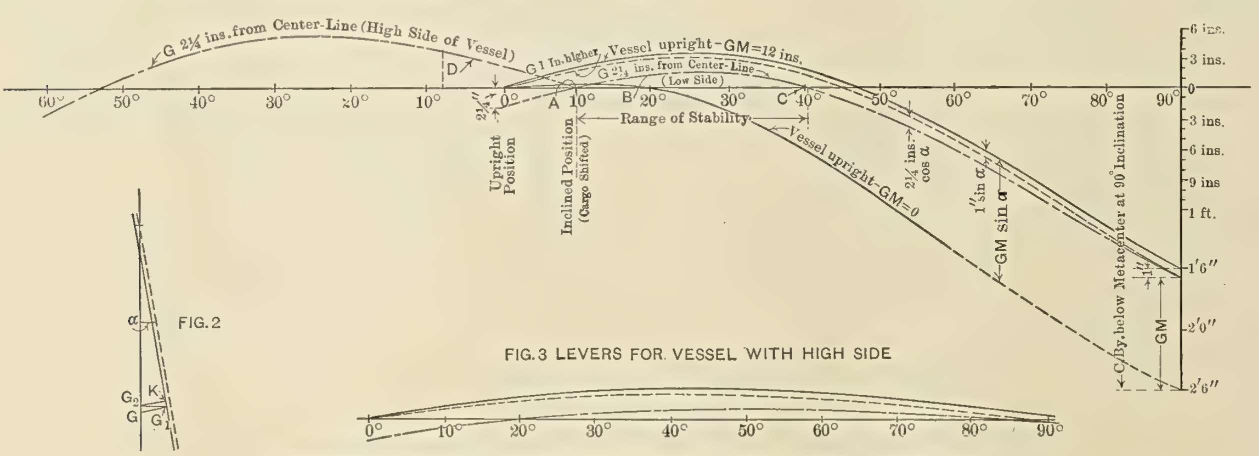
The stroke-and-dot curve in Fig. 1 represents the condition with cargo shifted, and is drawn for both sides of the vessel. The range of stability, which originally extended from 0 to 47 degrees, has been reduced by the shifting of the cargo to one extending from 10 to 41 degrees, *i. e.*, by about one-third and the height of the curve, or length of the longest lever, is now only $1\frac{1}{2}$ inches, instead of about $3\frac{1}{2}$ inches as originally.

The port levers are lengthened by the amounts by which the starboard ones are shortened.

If the vessel rolls 16 degrees to port, she will pass the upright position and heel to 8 degrees on that side. Inasmuch as the dynamical reserve of stability on her starboard side, represented by the area of the curve *ABC*, is less than that of the piece of the starboard curve *AD*, the return roll will capsize her.

For a seagoing vessel in ordinary grain-carrying trim, the list shown is a heavy one, but it is one that may occur, and it serves to illustrate the danger accompanying shifting of the cargo. It will be observed that a list of 10 degrees alters the difference being that for sailing a sufficient reserve would usually be provided. The danger most resembles that which threatens a broad, flat-bottomed sailing ship in ballast, which, with a short range of stability, can carry a large spread of canvas on a comparatively light draft, but may in so doing have almost swallowed up her reserve. Such a vessel is uncomfortable at sea, and an unwary captain is apt to counteract this by taking in too little ballast and thereupon to disappear with all hands, leaving behind him one more unsolved mystery of the sea.

FIG. 1 CURVES OF RIGHTING LEVERS



CURVES ILLUSTRATING EFFECT OF SHIFTING CARGO ON THE STABILITY OF A VESSEL.

capsizing point from 47 to 41 degrees at the same time. Should the vessel list to 25 degrees, she would capsize then and there.

When cargo has shifted, the usual experience is, that after the vessel has once taken a list, she gradually heels over to a still greater angle. The causes of this are that the grain gradually settles, the feeders ceasing to do their work at the angle assumed, and, further, that bilge water and loose objects of all kinds gradually go over to the low side.

The case of a vessel with an exceptionally high side, or of a timber carrier in which a securely lashed deck load is practically part of the structure and represents an increase of its height, is different from the one just considered, in that the curve of levers has a much greater range—perhaps even extending past the inclination of 90 degrees. For such a vessel the curve may take the form shown in Fig 3.

She is theoretically incapsizable, but she may heel over to angles so great that she becomes unmanageable and inhabitable, or the deck load which then hangs from its lashing may break away from these—it may be on one side only, and the cargo, perhaps also the vessel, may be lost in consequence.

Figs. 3 and 1 further illustrate the safety in the one case, and danger in the other, of going to sea with a list. Within reasonable limits the narrow, deep vessel, with high freeboard may do this with comparative impunity, while the broad, shallow one, with low freeboard, would run a very grave risk.

The shifting of a vessel's cargo has nearly the same effect upon her as if a steady wind were acting on a suit of sails, the

LAUNCH OF THE BATTLESHIP FLORIDA.

The United States battleship *Florida* was successfully launched from the Brooklyn navy yard, Brooklyn, N. Y., May 12. The *Florida* is a sister ship of the Utah, which was launched from the yards of the New York Shipbuilding Company, Camden, N. J., Dec. 23, 1909.

The keel of the *Florida* was laid in March of last year and the construction has progressed without delay in a most satisfactory manner until at the time of her launching she was about 69 percent completed. Viewed in comparison with the present Dreadnoughts of the American navy, the *North Dakota* and *Delaware*, the *Florida* is considerably larger, but not as speedy. Her over all dimensions are 521 feet 6 inches length and 88 feet 3 inches breadth, with a mean draft of 28 feet 6 inches when carrying a full supply of ammunition and a two-thirds supply of fuel and stores. On this draft her displacement is 21,825 tons. She carries 2,500 tons of coal and 400 of oil fuel. The outward appearance of the *Florida* will resemble greatly that of the *North Dakota*, with two smokestacks, two lattice observation masts and five turrets, each with two 12-inch 45-calibre guns, mounted on the center line of the ship.

The machinery installation of the *Florida* will consist of steam turbines and watertube boilers, together with the usual auxiliary machinery, electric lighting machinery, steam heating and evaporating plants, deck machinery and appurtenances for handling and maneuvering.

The turbine machinery will be of Parsons type, and will consist of ten turbine units on four shafts, and will be arranged in such a way that one high-pressure ahead turbine and one backing turbine (both independent of one another) will be placed on the outboard shafts, and the low-pressure ahead and backing turbines (in one casing), together with the high-pressure cruising turbine on the port side and the intermediate pressure-cruising turbine and a low-pressure ahead and backing turbine on the starboard side, will drive the inboard shafts. As in most of Parsons four-shaft arrange-

ments the outboard turbines turn inboard and the inboard turbines turn outboard. The engine room has a central fore-and-aft bulkhead dividing the engine power in two completely independent sections, each with complete sets of auxiliary machinery consisting of condensers, wet single-acting double vertical air pumps, centrifugal circulating pumps, main feed and other pumps, auxiliary condensers, etc. The twelve Babcock & Wilcox boilers will be placed in three watertight independent compartments, each with a double fire room.

The steam pressure at the boilers will be about 200 pounds, and 175 pounds at the throttle valve of the high-pressure turbines. As Parsons turbines do not operate advantageously with superheated steam, the boilers are not provided with superheaters.

When running full speed the revolutions per minute of the turbines will be about 330, and the horsepower developed about 28,000. It is understood the trial requirements of the *Utah* and *Florida* are to be similar to those laid down in the case of the *North Dakota* and *Delaware,* which had one 4-hour full-speed trial, one 24-hour endurance and coal consumption trial at 19 knots, and one 24-hour endurance and coal consumption trial at 12 knots. The maximum speed required of the *Florida* is 20¾ knots in a run of 4 hours.

A NEW TYPE OF IRON ORE TRANSPORT.

BY F. C. COLEMAN.

One of the most interesting types of vessels now being used for the transport of iron ore is the steamship *Vollrath Tham,* which has recently been constructed to the order of the Rederiaktiebolaget Luleä-Ofoten, by Messrs. R. & W. Hawthorn, Leslie & Co., Ltd., of Hebburn-on-Tyne. The vessel, built to the British Corporation highest class, has a length over all of 390 feet, a length between perpendiculars, over stem and stern post, of 376 feet, a breadth of 56 feet 6 inches, a depth of 33 feet 6 inches, and a deadweight capacity of 8,000 tons. She has been fitted by the North Eastern Marine Engineering Company, Ltd., with triple-expansion engines, and steam is supplied from three cylindrical multitubular boilers working at a pressure of 180 pounds per square inch. There are two powerful ballast pumps capable of delivering 600 tons per hour. On her trials the *Vollrath Tham* attained a speed of over 10 knots, and on the occasion of her maiden voyage, in ballast, from the Tyne to Narvik, the average speed exceeded 10½ knots.

The vessel has been specially designed to carry iron ore, with a view to quick and economical loading and discharging, and, in substitution for the ordinary holds, she has been divided into a series of hoppers and discharging holds. Before the

U. S. BATTLESHIP FLORIDA ON THE WAYS AT THE BROOKLYN NAVY YARD. (Photograph by Muller.)

construction of the vessel was begun, a series of prolonged experiments were carried out at the Hebburn shipyard with a quantity of the actual ore, so as to ascertain the most efficient mechanical device for operating the doors; the correct angle of slope for the various ridges, the proper size for the shoots having previously been obtained from experiments

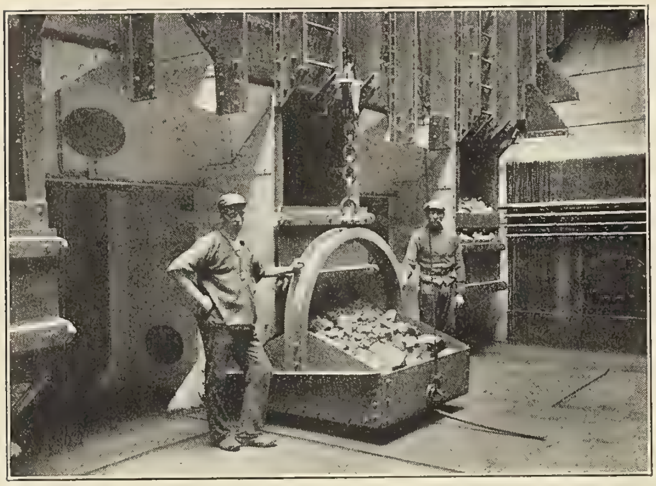


FIG. 1.—DISCHARGING HOLD AND ORE SKIP.

carried out in one of the ordinary vessels of the Rederiaktiebolaget Luleä-Ofoten. As a result, the hoppers are raised some distance from the tank top, and they have been constructed in a substantial manner, with bases sloping 42 degrees to the horizontal, the ore traveling to a series of four shoots, each of which is manipulated from the discharging holds. The door of each of these shoots is fitted with a lever, about 7 feet in length, and the door moves with a parallel motion eccentrically, thus relieving the pressure of the ore on the door, and permitting the door to be easily opened by one man. Upon the skip attached to the crane rope being lowered into position, the attendant is enabled, by operating the door lever, to arrange for the requisite

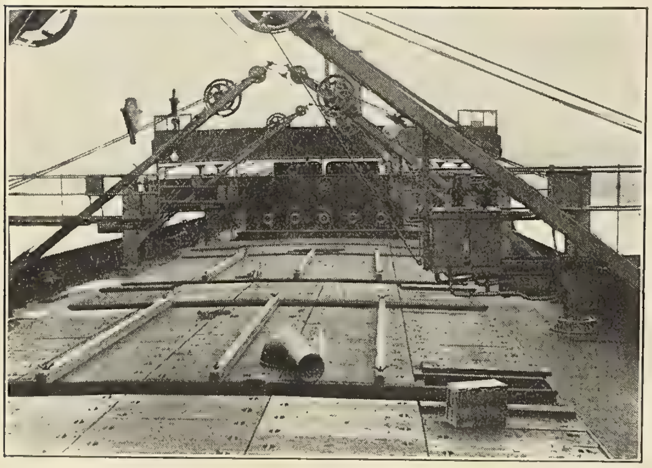


FIG. 2.—VIEW ON THE FORWARD DECK, SHOWING CRANES AND HATCHES.

amount of ore to travel into it. Thereupon, the door having been dropped, the bucket is drawn to the top, the craneman having had the whole operation under his observation.

The hatchways, 2 feet 6 inches high above the deck level, are formed of continuous longitudinal girders divided by athwartship plates, and they were designed to suit the loading arrangements at Narvik, at which port the spouts are placed at intervals of about 13 feet. These hatchways being of somewhat unusual dimensions, special provision was made for securing the covers by means of a number of wooden beams.

Having been specially designed for the transport of ore, the *Vollrath Tham* must necessarily perform half of the round voyage light, and has, therefore, been constructed to carry an increased amount of ballast, and has, in addition to the double bottom, been fitted with wing tanks, giving her a total capacity for water ballast of about 3,000 tons. As these wing tanks are required to support a great bulk of the ore, they have been built of very substantial scantlings and divided up at intervals of about 12 feet by complete or partial bulkheads. To maintain their watertightness against the falling of the ore, the tanks have been sheathed with 5½ inches of pine, covered with ⅜ inch steel plate in the way of the ore hoppers, and, as the tanks are continuous, they give great longi-

FIG. 3.—CRANES DISCHARGING ORE INTO LIGHTERS.

tudinal strength—a matter of considerable importance in an ore vessel, owing to the irregular distribution of the loads.

The electrical equipment, both for power and lighting purposes and for the operation of the cranes, has been carried out by Siemens Brothers Dynamo Works, Ltd., Stafford. The generating plant and switchboard are fitted in a separate machinery room at the after end of the vessel immediately aft of the main engines. There are two duplicate generating sets, each consisting of a Brotherhood compound engine of the enclosed type, with forced lubrication, running at 400 revolutions per minute, and coupled direct to a Siemens multitubular compound wound generator, capable of developing 75 kilowatts at 220 volts. The electric lighting set comprises a Brotherhood engine, with forced lubrication coupled direct to a compound wound dynamo developing 64.5 amperes at 110 volts. The switchboard is divided into three panels, one for the lighting set and one for each power generating set, fitted

with automatic circuit breakers and change-over switches, so arranged that either generator can be used for working the cranes at either side of the vessel.

There are ten electric cranes, five on each side of the vessel, and each of these has a lifting capacity of 2½ tons, with a speed of 75 feet per minute. The cranes are of a special type, having their mechanism all below deck level, and the post is fitted with gland end stuffing-box, so that the crane room is continuously watertight. On the side of the jib is fitted the operating platform, which is so arranged that the craneman is able to see all the movements of the skip when loading and emptying the same. The two controllers are together and they are fitted with one lever, which is so arranged that the load follows the direction of the movement of the lever. By the operation of a lever, which is within easy reach of the crane platform, the skip, which has a carrying capacity of about 2 tons of ore, may be tipped in any position. Fig. 3 gives a view of three of the cranes on one side of the vessel, and of the ore being tipped from two of the skips into lighters at Emden. Experience has proved that, by means of one of these cranes, 40 to 50 tons can be discharged in the course of an hour. We understand that, on the occasion of the first voyage of the *Vollrath Tham*, from Narvik to Philadelphia, Pa., her cargo of 8,200 tons was discharged in 47 working hours by a staff of fifteen men from the ship's crew, and with only five of the cranes working, the consumption of coal, meanwhile, being 10 tons.

In the design of the *Vollrath Tham*, regard was paid, not so much to securing a reduction in the terminal time as the reduction in the cost of labor in discharging at port, and, with a vessel of similar capacity, but built on the ordinary principle, it is claimed that 120 men would have to be engaged 40 hours, and that the coal consumption would amount to about 30 tons.

As the mines from which this Swedish ore is obtained are situated within the Arctic circle, and the stone is sent down to Narvik in a wet state, there is provided under each of the ore pockets in the *Vollrath Tham* a special boiler and system of steam pipes for use in the winter season.

The equipment of the vessel is of the most complete description and includes Welin's patent davits, together with Engelhardt's patent collapsible lifeboats, and also telemotor steering gear. The captain and officers have commodious quarters at the after end of the ship, and amidships there is also a captain's room, while the crew are berthed forward.

The Rederiaktiebolaget Luleä-Ofoten is a transport company subsidiary to the Trafik Aktiebolaget Grangesberg-Oxelosund, of Stockholm, who, as one of the largest mining syndicates in Northern Europe, work the extensive iron ore mines at Gellivare and Kirunavaara, in Lapland, which, together, produce more than one-half of the total amount of ore obtained in Sweden. By means of the Ofoten-Luleä State Railway, which runs alongside Lake Tornea, and is the most northerly railway line in the world, these mines have connections with the shipping ports of Luleä (Sweden) and Narvik (Norway). Narvik is a comparatively new port, and, although at latitude 68 degrees 26 N., it is free from ice all the year round. The Trafik Aktiebolaget Grangesberg-Oxelosund, of Stockholm, who annually ship from Narvik some two and a half million tons of ore, possess at this place large storage ground fitted with the most approved appliances for the economical and expeditious handling of large consignments of ore, which are capable of dealing with about a thousand tons of ore per hour, and alongside side which there is a depth of 27 feet at all states of the tide.

The *Vollrath Tham* was built by Messrs. R. & W. Hawthorn, Leslie & Co., Ltd., to the designs, and under the patents of Messrs. Johnson & Welin, of Gothenburg and Stockholm.

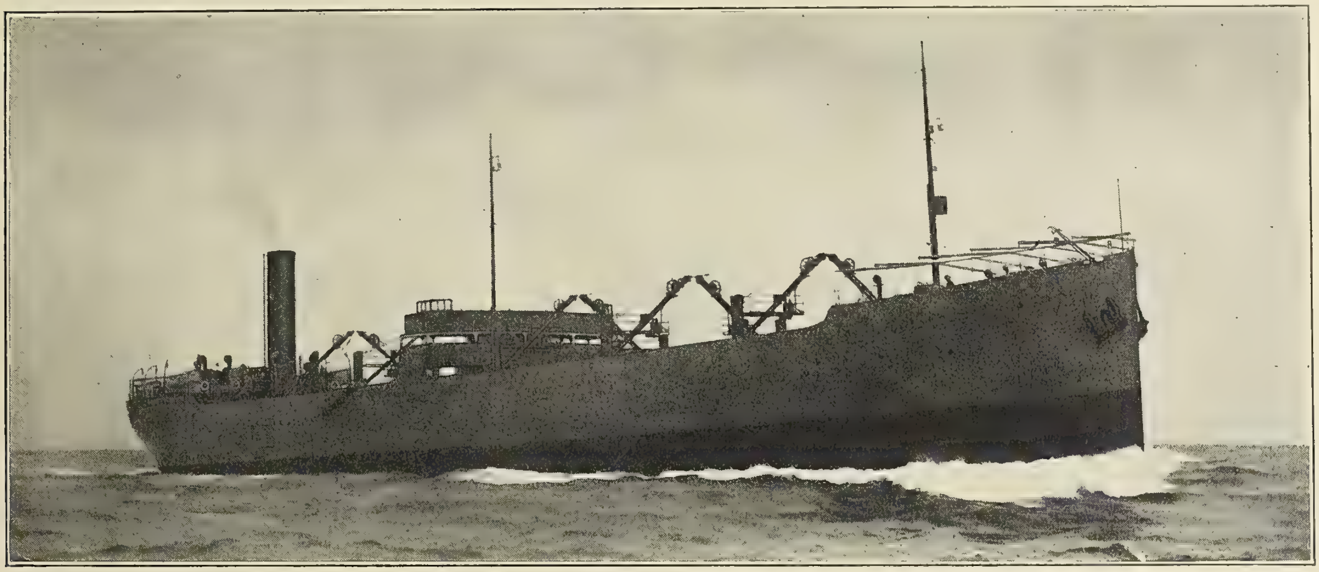


FIG. 4.—NEW TYPE OF ORE CARRYING STEAMSHIP, THE VOLLRATH THAM.

The battleship *Louisiana*, built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has made a record of 19.08 knots for four consecutive hours, thereby proving herself the fastest battleship in the Atlantic fleet of the United States navy. This record is remarkable, in that the displacement of the vessel was about 1,000 tons greater than on her contractors' trials. Her propellers have recently been changed to turn outboard when going ahead instead of inboard, as formerly, and it is believed that this had much to do with the increase in speed.

The American Society of Naval Engineers held its second annual banquet at Washington on May 7. Among the 200 members and guests present were the Secretary of the Navy, the Speaker of the House of Representatives, a number of officers of high rank, members of Congress and distinguished engineers.

FIRE BOATS DAVID SCANNEL AND DENNIS T. SULLIVAN FOR SAN FRANCISCO HARBOR.

Two new fire boats for the city of San Francisco have recently been completed by the Risdon Iron Works. These boats were built from designs prepared by Marsden Manson, civil engineer, of San Francisco, assisted by T. W. Ranson, consulting mechanical engineer. The principal dimensions of the boats are as follows:

Length over all	129 feet
Length between perpendiculars	120 feet
Beam molded	26 feet
Depth molded	12 feet 9 inches

The hull is of the single-deck type, with a deck house over the space occupied by the boilers and machinery, with a raised pilot house at the forward end of the deck house. The hull is constructed with a flat plate keel, elliptical stern and straight stem. Forward and aft the hull is cut away, as shown on the sheer plan, and a balanced rudder is fitted. The ship is divided into five compartments by four watertight thwartship bulkheads, and, in addition, oil-tight tanks with a storage of fuel oil are fitted, as shown in the drawings.

HULL CONSTRUCTION

The flat plate keel is 48 inches wide, of 18-pound plate, for 3/5 length amidships reduced to 16 pounds at the ends. The stem is of hammered steel, 6 inches by 1⅜ inches in a single length, the lower end being scarfed to the flat plate keel. The stern frame is in one piece of cast steel, molded 6½ inches and sided 3½ inches. The rudder post extends to the deck and is secured to the transom. The rudder itself is of the balanced type and is one piece of cast steel. Its weight is carried on deck by means of a cast iron deck plate having a flat bearing filled with white metal.

The center keelson is built of a continuous 14-pound plate, 2 feet 9 inches deep, connected to the keel by double angles, 3 inches by 3 inches by 7 pounds. A flat keelson plate, 24 inches wide and of 16 pounds weight, is fitted to the top of the keelson and connected to it by double angles, also 3 inches by 3 inches by 7 pounds.

The framing of the vessel consists of main frames of 3-inch by 3-inch by 7-pound angles, spaced 21 inches between centers. They extend in one piece from the keel to the deck stringer plate, except in way of the fuel oil tanks. Reverse frames of 2½-inch by 2½-inch by 5-pound angles are fitted on every frame in continuous lengths from the center line to the deck stringer and to 6 inches above the lower side stringer alternately, except in way of the fuel tanks, where they are cut at the oil tank bulkhead. All frames in the engine and boiler rooms are fitted with double reverse angles, extending from the turn of the bilge to the turn of the bilge in the engine room, and from tank bulkhead to tank bulkhead in the boiler room.

Floor plates are fitted to every frame. These are 33 inches deep at the center keelson amidships and increase in depth at the ends and under the engines from frame 15 to frame 20. The floor plates are carried straight on top from bilge to bilge, except in way of the oil tanks, where they are turned up to have a landing on the longitudinal bulkhead not less than 12 inches. The floor plates under the boilers are of 16-pound plate; under the engines and pumps they are of 14-pound, and elsewhere of 12-pound plate. At the watertight bulkheads they are of 14-pound plate and extend 9 inches above the keelson angles. The transom plate is 20 pounds to the square foot.

Bilge stringers extend fore and aft, and consist of double 3-inch by 3-inch by 7-pound angles, fitted back to back and riveted to the reverse frames and to angle clips, except under the engines, pumps and boilers. Under the boilers they are replaced by 14-pound intercostal plates, worked so as to take the outside holding-down bolts of the boilers, and are secured to the shell plating and floors with 3-inch by 3-inch by 7-pound angle clips, and to a rider plate by 5-inch by 3-inch by 12.8-pound angles. Under the fire pumps 14-pound intercostals are worked, so as to take the outer row of holding-down bolts. These are secured to the shell plating and floors with 3-inch by 3-inch by 7-pound angle clips, and to the rider plate by 5-inch by 3-inch by 12.8-pound angles. A 20-pound rider is worked over the top of the floors extending to the center keelson. Shoes of 5-inch by 3-inch by 12.8-pound angles are worked intercostal below the rider plate in way of the inner row of pump holding-down bolts. Under the engine the floor plates, from frames 15 to 20 inclusive, extend to the under side of the engine seat. Double reverse angles are worked on top of the floors from bilge to bilge. Intercostals of 14-pound plate are worked under the engines in way of the holding-down bolts. The outer intercostal extends to the shell plating and is secured to the floors with 3-inch by 3-inch by 7-pound angle clips, while the inner intercostal extends down to 3 inches above the top of the center keelson and is secured to the floor plates with 3-inch by 3-inch by 7-pound angle clips.

There are two side stringers of double 3-inch by 3-inch by 7-pound angles riveted back to back and to the reverse frames. The lower-side stringers extend from frame 12 to frame 51, and are bracketed to the bulkheads at each end with 12-pound plates. The upper-side stringers extend all fore and aft, and are connected at the ends of the vessel with 12-pound plates forming breast hooks. All keelson bars are carried continuously through the 'thwartship watertight bulkheads, with watertight collars fitted around them, but they are cut at oil-tight bulkheads with 18-inch by 18-inch by 14-pound brackets on either side.

The main deck beams are 5-inch by 2½-inch by 10-pound bulb angles, fitted on every frame and connected to the frames by 12-pound bracket plates 15 inches deep. The beams at the forward end of the engine room and under the tow bits are 8-inch by 3½-inch by 19.25-pound bulb angles. The lower deck beams forward and aft of the machinery space are 3½-inch by 2½-inch by 8-pound angles, fitted on every frame and connected to the frames by 12-inch by 12-inch by 10-pound bracket plates. The same size beams are used on the upper deck.

The shell plating on the sides and bilges is of 14-pound plate for half-length amidships reduced to 12-pounds at the ends. The sheer strake is of 16-pound plate for half-length amidships, and 14 pounds at the ends. The garboard strake is of 16-pound plate throughout. The bulwark plating is of 10 pounds.

As previously stated, there are four watertight bulkheads. These are built of 10-pound plating above the floors and are braced with both vertical and horizontal stiffeners of 3½-inch by 2½-inch by 8-pound angles. The vertical stiffeners are spaced two feet apart, the lower ends extending well down over the floor plates. The horizontal stiffeners are spaced four feet apart and are bracketed to the shell plating.

The main deck shell plating is of 12-pound plate, and the main deck stringer is of 12-pound plate, 54 inches wide in way of the deck house, tapering to 20 inches at the ends. On top of the deck house and on the lower decks forward and aft of the machinery space the decks are of 10-pound plating.

FUEL OIL TANKS.

Tanks for the storage of fuel oil are located, as shown on the plans. The frames in way of these tanks are cut and a continuous 4-inch by 4-inch by 9.8-pound angle is riveted to the shell plating and the fore and aft bulkheads which

form the sides of the tank. The lower strake of plating is 14 pounds, and the upper strake 12 pounds. The lower strake of the longitudinal bulkhead is flanged outwardly from the tops of the floors at such an angle as to meet the shell plating at an angle of 90 degrees. The floors at the forward end are carried level out to the edge of the boiler foundation, and then bent up so that the depth at the point of meeting with the longitudinal bulkhead is not less than 12 inches. Vertical stiffeners are fitted at each frame, consisting of 3½-inch by 2½-inch by 8-pound angles, carried well down to the frame angles and riveted to bulkhead and floor-plating brackets on the inside of the bulkhead. Brackets of 14-pound plate are fitted between the ends of floor plates and frames on the side. Each tank is divided into three separate oil tight compartments by intermediate bulkheads. The plates in these bulkheads are 14 pounds at the bottom and 12 pounds above, secured to the shell plating and to the longitudinal bulkhead with 4-inch by 4-inch by 9.8-pound angles. A horizontal stiffener of 8-inch by 3½-inch by 19.25-pound bulb angles is fitted in the tanks and securely bracketed to the 'thwartship bulkheads.

WATER TOWER.

The water tower is a square-latticed column, about 26 feet high above the upper deck. It is 4 feet square at the base, and 2 feet square at the top, and is built of 3½-inch by 3½-inch by 8.5-pound angles at the corners, and cross-latticed with 2-inch bars and gussets. The corner angles are carried down to the main deck and well secured to the 'thwartship bulkheads in the deck house. A platform, about 7 feet in diameter, is fitted about 2 feet below the top of the tower.

PROPELLING MACHINERY.

The main engines are of the direct-acting, inverted cylinder, compound type, having cylinders 13 inches and 28 inches diameter, with a common stroke of 20 inches. All valves are worked by the Stephenson link motion, and a steam reversing engine is fitted at the back of each engine and secured to one of the back columns. The engine cylinders are cast separately, with the steam chests outside or away from the center of the engine. The high-pressure cylinder is fitted with a piston valve and solid cast iron packing rings, arranged to take steam on the inside edges. The upper end of the piston valve is larger at the lower part, so as to balance the weight of the working parts of the valve gear. Cast iron liners are fitted in the steam chest.

THE DENNIS T. SULLIVAN, ONE OF SAN FRANCISCO'S NEW FIREBOATS.

The low-pressure cylinder is fitted with a double-ported balanced slide valve, the valve seat of which is of close-grained cast iron, secured to the cylinder casting with countersunk Tobin bronze screws. The steam passages and pipes are designed for steam speeds not exceeding the following velocities when the engine is turning at 140 revolutions per minute.

	Feet per minute.
High-pressure ports	5,000
Low-pressure ports	6,500
Receiver pipe	6,000
Condenser pipe	6,500

The minimum thickness of the high-pressure cylinder walls is 1⅛ inches. The cylinders are fitted together and to their supports by twin bolts driven into reamed holes. The lineal clearance in each cylinder is ⅝ inch divided between the

two ends to the best advantage. Relief valves, with a minimum diameter of 2 inches, with composition valves and seats and adjustable springs, are fitted to each end of each cylinder and to the receiver.

The engine framing consists of two front columns of forged steel 4 inches in diameter, the back columns being of cast iron, with the brackets for the crosshead guides cast upon them.

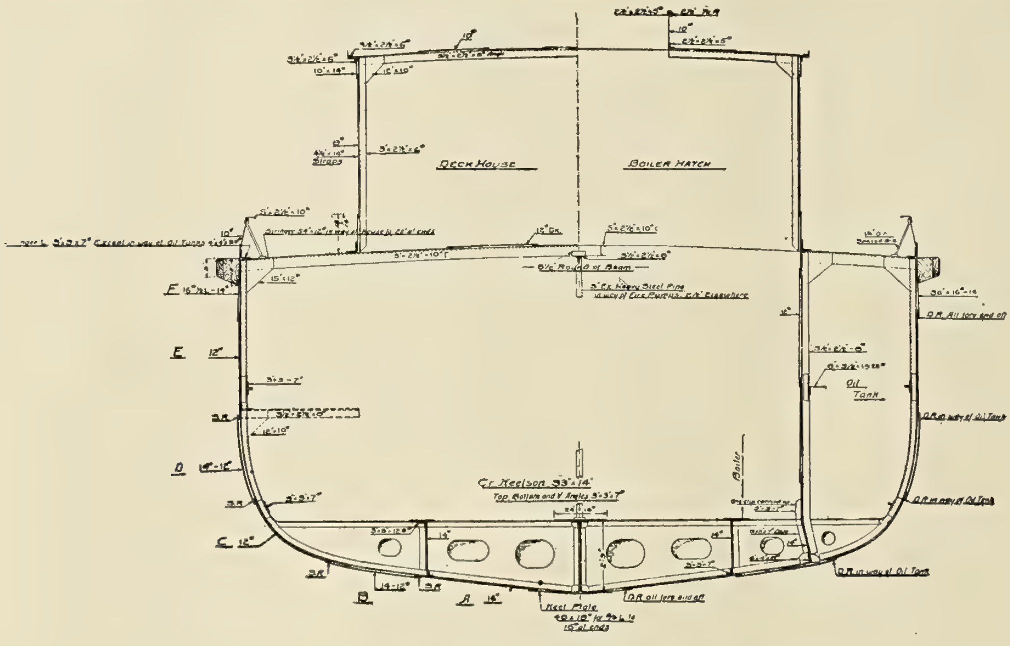
The pistons are of cast iron, 5 inches deep, fitted with followers. The high-pressure piston is fitted with two cast iron snap rings each ½ inch wide by 1 inch thick. The low-pressure follower is the full depth of the piston and is fitted with two cast iron snap rings, ¾ inch square, fitted in the usual manner. The snap rings are arranged so that they travel ⅛ inch over the counter bore at the ends of the cylinders. The piston rods are of forged steel, 3 inches in diameter. The crossheads are of forged steel, with pins 3½ inches diameter by 4 inches long, forged solid with the cross-heads. The cross-head block is secured by fitted bolts to a cast iron slide block of the locomotive type completely embracing the guide, lined with white metal, and so designed as to permit of readily taking up the wear. The shoes are 8½ inches wide by 10 inches long. The cross-head guides are of hard, close-grained cast iron, each being a rectangular bar, 3½ inches by 8 inches, cored out for water circulation and finished all over. The connecting rods are of mild steel, forged from a solid bloom without welds. The top end is forked to take the cross-head brasses, and the bottom end has a T-head. The length from the center of the cross-head brasses to the center of the crank pin boxes is 44 inches, and the diameter at the large end is 3½ inches tapering to 2¾ inches at the small end. The crank pin boxes are of cast steel, lined with white metal, and the cross-head boxes are of composition not lined.

The engine-bed plate is of the box style of cast iron, riveted to the engine seat. The bearings are of cast iron, lined with white metal, and so arranged as to be readily removed without raising the shaft. There are three journals, each 6 inches bore. The end journals are 8½ inches long, and the center one 11 inches long.

The crank-shaft is 6 inches in diameter, of forged steel, in once piece. The cranks are set at an angle of 90 degrees, with the high-pressure crank leading. The crank pins are 6 inches in diameter by 8 inches long.

The intermediate and propeller shafting is of the same quality as the crankshaft and the same diameter throughout. The thrust bearing is of the horseshoe type, secured to the engine bed plate and to the engine seat by body-bound steel bolts. The half bearing is 6 inches long. There are three horseshoes of cast iron, bored out for water circulation, lined with white metal and properly grooved for lubrication.

The reversing links are of forged steel of the double-bar type; the distance between centers of eccentric rod pins being 12 inches. The link blocks are of composition, fitted with adjustable gibs, to take up wear. The drag links are round steel bars, 1¼ inches in diameter.



MIDSHIP SECTION OF THE NEW SAN FRANCISCO FIREBOATS.

The reversing engine consists of a steam cylinder, 5 inches in diameter and 9 inches stroke, acting on a forged steel arm secured to the rocking shaft.

The main bearings, crank pins and thrust are fitted with water service pipes of brass, and the cross-head guides are fitted with brass or copper pipes for water circulation, the water supply being taken from the circulating pump delivery to the condenser. The main bearings, crank pins, cross-head guides, cross-head journals, thrust and eccentric straps are fitted with lubricating boxes and brass fitting pipes. The oil supply for crank pins, cross-heads and guides is taken from oil boxes secured to the cylinders, and the main steam pipe is fitted with a sight-feed lubricator.

The stern tube bearings consist of a composition sleeve, made in halves and lined with sections of lignum vitæ. The thrust bearing is 24 inches long, and the diameters of the bearings are so arranged that the shafts may be withdrawn outboard whenever the sleeve couplings have been removed. The stern tube stuffing boxes are fitted at the forward ends of the stern tubes and are made of composition bored out for threads with six turns of ¾-inch packing.

The propellers are four-bladed cast iron wheels, each 7 feet 6 inches diameter and 11 feet 6 inches pitch.

There are two watertube boilers of the large, straight-tube type, placed fore and aft with the fire-room between them. The forward boiler contains 2,640 square feet of heating surface and the after boiler about 2,760 square feet of heating surface. Both boilers are built for a working steam pressure

of 200 pounds per square inch. The tubes are all made of seamless steel, 4 inches and 2 inches diameter. Instead of being fitted with grate bars and as usually constructed, these boilers will be fitted with brick furnaces for the use of crude oil as fuel. The oil burners have a capacity for evaporizing 18,000 pounds of water per hour from each boiler when the boilers are in good condition. It is required that the full steam pressure shall be maintained when both engines and both fire-pumping sets are in operation simultaneously.

FIRE PUMPS.

There are two sets of fire pumps in each boat, located amidships between the main engines and the boiler. Each set consists of two pumps of the multi-stage centrifugal type, each capable of delivering not less than 2,000 gallons per minute, against a pressure of 150 pounds per square inch, connected directly to the shaft of and driven by a steam turbine capable of delivering 600 brake-horsepower. The pumps and turbine are mounted on one bed plate. The turbine has a 5-inch steam inlet and an 18-inch exhaust outlet. Both the suction and delivery inlets of each pump are 10 inches.

Two 3-inch stationary monitors are fitted, one on the deck house aft of the boiler casing, and one on top of the pilot house. The end of the play pipe is fitted with a nozzle, 3 inches inside diameter at the smaller end and 4 taps are furnished 2¾-inch, 2½-inch, 2¼-inch and 2-inch diameter, respectively, for each monitor. There are also two portable monitors fitted with a 2-inch diameter nozzle. The play pipe on the water tower is of the same size as the 3-inch monitor.

AUXILIARIES.

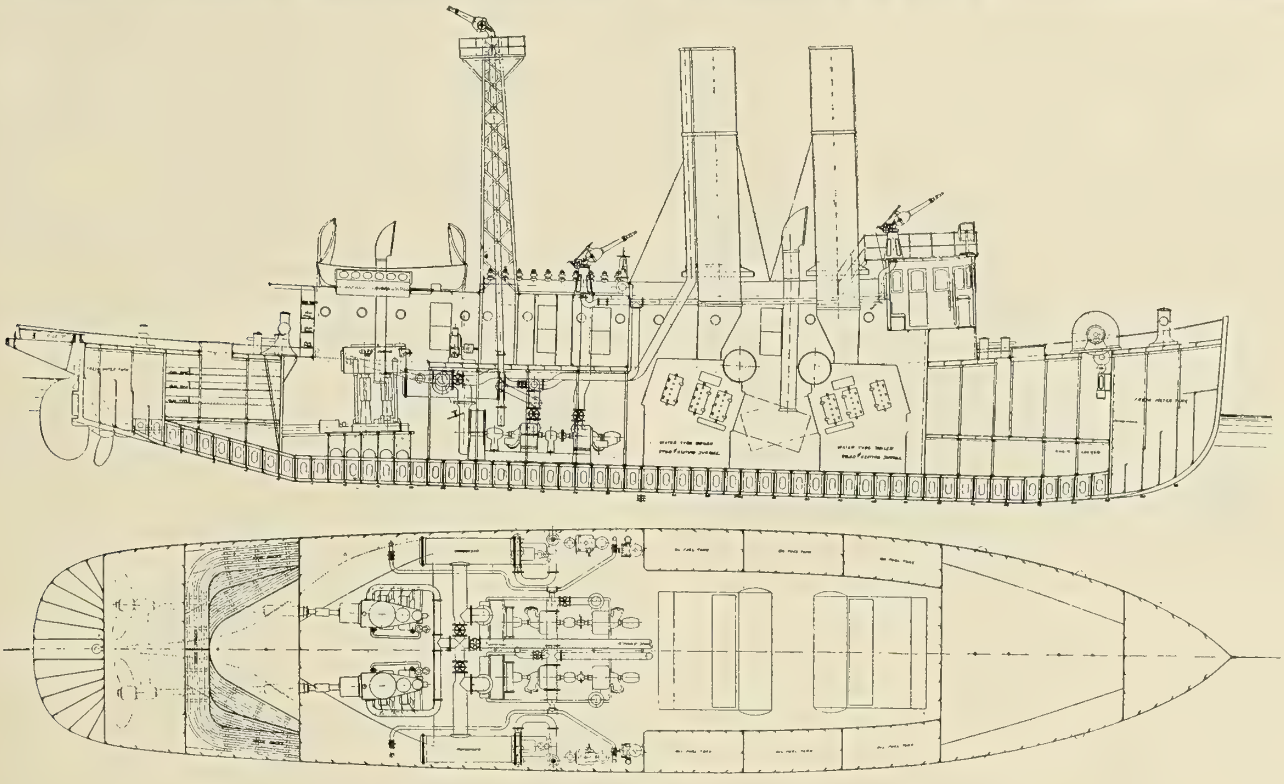
There are two separate surface condensers in the engine room, located at the sides of the vessel and supported under the deck beams. Each condenser is cylindrical, about 34 inches in diameter and 9 feet 9¼ inches long between tube sheets, containing about 1,350 square feet of cooling surface measured on the outside of the tubes. The shell is of a single sheet of steel, ⅜ inch thick, fitted with cast iron flanges riveted to each end for securing the tube sheets and heads. The tube sheets are of rolled Muntz metal, 1¼ inches thick. The tube holes are tapped and fitted with screw glands for packing the tubes. The glands are of phosphor bronze, 1⅛ inches in diameter by ⅞ inch long, and threaded with 16 threads per inch.

The water chests are of cast iron, and one chest is made with the horizontal division plate so arranged that the circulating water passes twice through the condenser tubes before going overboard. The water chests and tube sheets are secured to the cast iron flanges on the ends of the shell with ¾-inch Tobin bronze bolts and composition nuts.

There are 600 seamless drawn tubes in each condenser, ⅞ inch in diameter outside, 16 B. W. G. in thickness, 10 feet long and spaced 15/16 inches centers.

The circulating pump is of the centrifugal type, having a capacity of over 2,000 gallons per minute. It is connected to the shaft of a single cylinder, inverted, direct-acting, open-front type, 6-inch by 7-inch engine. The pump is constructed with cast iron casing, composition runner, bearings and fittings and a Tobin bronze shaft. The inlet and discharge openings are 9 inches in diameter, and the pump is connected to draw from either the sea or the bilge, and discharge through the condenser overboard. The runner is about 30 inches in diameter. The circulating pump engine takes steam from the auxiliary steam line and exhausts to the condenser, heater, or escape pipe. There are two main and auxiliary feed pumps located in the engine room of the vertical, single-piston type, having steam cylinders 10 inches in diameter, water cylinder 7 inches in diameter and a common stroke of 18 inches. The pumps are designed for a working pressure of 200 pounds per square inch. One is located alongside the feed-water tank, to be connected for use as the main-feed pump. This draws from the feed-water tank and discharges to the main-feed pipe. The other pump is connected to draw from the feed-water tank, or sea, and discharge through the main or auxiliary feed line.

The air pumps, two in number, are located in the engine

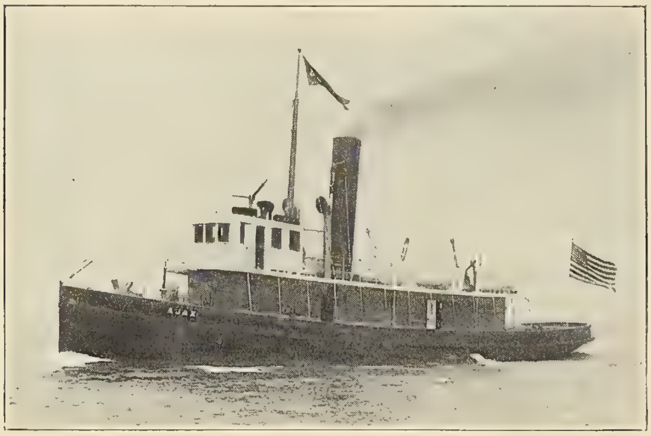


INBOARD PROFILE AND HOLD PLAN, SHOWING ARRANGEMENT OF MACHINERY.

room. They are of the vertical twin beam pattern, having two steam cylinders, 7.8 inches in diameter, two air cylinders, each 14 inches in diameter, with a common stroke of 10 inches. The donkey pump is of the vertical single-piston type, having a steam cylinder 6½ inches in diameter, a water cylinder 4¼ inches in diameter, and a common stroke of 10 inches.

The fuel oil pumps are of the horizontal duplex type, having steam cylinders 4½ inches in diameter, fuel oil cylinders 2¾ inches in diameter, and water cylinders 3 inches in diameter, with a common stroke of 4 inches. There are two of these pumps located, one on each side of the fire-room, alongside of the fuel oil tank bulkhead. A cylindrical heater of cast iron or steel, fitted with a seamless copper coil having 15 square feet of heating surface, is fitted to the pump frame. The capacity of the heater is over 35 gallons.

The steam-steering engine is located in the upper engine room, and consists of double engines having cylinders 4 inches in diameter by 5 inches stroke, driving a chain drum through gearing. About 75 revolutions of the engine are required to move the rudder hard over from port to starboard. This engine takes steam from the auxiliary steam line and exhausts either into the heater or into the atmosphere.



PACIFIC COAST TUG AND FIREBOAT.

A steam windlass is located on deck at the bow, which is driven by double engines having cylinders 6 inches in diameter by 6 inches stroke, bolted to the collision bulkhead under the deck. The windlass shaft, which is supported in cast iron standards, properly secured to the deck, is fitted with wild cats and gypsies at each end.

A feed and filter tank of about 500 gallons capacity, constructed of ¼-inch steel plate and angles, is located in the engine room. This is fitted with three division plates from the four compartments, three small and one large. The partitions are so arranged that the feed water entering at the top of the first compartment flows down and under the first partition into the second compartment, thence upward and over the top of the second partition into the third compartment; thence downward and under the third partition into the fourth and largest compartment. A quarter-inch steel plate, perforated with ¼-inch holes, is fitted near the bottom of the third compartment, to act as a screen and prevent any of the filtering material finding its way into the fourth compartment. The first three compartments are filled with filtering material. A feed-water heater of the direct-flow type is located in the engine room on the discharge side of the feed pumps and utilizes the heat of the exhaust from the auxiliaries. The total heating surface is about 150 square feet

An electric generating set, capable of delivering 10 kilowatts continuously when operated at 450 revolutions per minute under a steam pressure of 90 pounds per square inch and exhausting to the atmosphere, is installed in the upper engine room. The dynamo is a direct-current, 6-pole, compound-wound machine, capable of delivering a current of 91 amperes at a pressure of 110 volts, directly connected to the shaft of a vertical, direct-acting, inverted engine of the enclosed crank-case automatic type, having a single cylinder, 6½ inches in diameter by 5 inches stroke. The machine is designed for an overload of 25 percent in excess of the full load continuously for one hour without movement of the brushes or of injurious sparking, and 50 percent in excess of the full load momentarily without flashing over or injurious sparking. An 18-inch standard searchlight of the Carlisle-Finch make is mounted on the top of the pilot house, as shown in the illustration. This searchlight is 14 inches in diameter, of 5,000 candle power, fitted with glass mirrors and automatic mechanism, and arranged to be controlled from inside the pilot house. It is also fitted with 40-degree diverging lens, which can be controlled from the pilot house. The ship is lighted throughout by electricity.

FIRE TUG AJAX, OF THE SOUTHERN PACIFIC RAILWAY COMPANY.

The *Ajax* is a single-screw steel tug and fire-boat built by the Moran Company, of Seattle, in 1908, for service on San Francisco Bay. Both hull and machinery are of substantial construction throughout, and equal to the highest class of the American Bureau of Shipping.

Her principal dimensions are as follows:

Length between perpendiculars	103 feet 6 inches
Length over all	110 feet 0 inches
Beam, molded	21 feet 0 inches
Depth, molded	12 feet 6 inches
Gross tonnage	175

The hull and deckhouse are built of steel, with a partial steel main deck. The frames are spaced 21-inch centers and are built of 3½-inch by 2½-inch by 5/20-inch angles, with reverse bars 2½ inches by 2½ inches by 5/20 inch on every frame carried to the bilge. The garboard and sheer-strakes and the bilge strake for one-half length are of 12½ pound plating. All other steel plating in general varies from 10 pounds amidships to 8 pounds at the ends. The hull is divided into five watertight compartments by four watertight bulkheads. The deck house is of 7½-inch steel plates, with 12½-inch coamings, all stiffened by angles placed 21 inches centers.

The vessel has accommodations for a crew of ten on her forward lower deck, and four staterooms for officers on the after lower deck. The galley and mess room are located in the deck house.

The steering gear is of the combined steam and hand type readily changeable from one to the other. Electricity for lighting purposes is furnished by a direct-connected generator. The windlass is of the tow-boat type, fitted with two wild-cats and two gypsies. A large towing bit is located aft of the deck house. Two bollards are fitted on the bow and two on the quarter.

This vessel's propelling machinery consists of a three-cylinder inverted, triple-expansion engine. The high-pressure cylinder is 15 inches in diameter; the intermediate-pressure cylinder 24 inches in diameter, and the low-pressure cylinder 38 inches in diameter.

Steam is furnished by one Babcock & Wilcox marine water-tube boiler having 2,400 square feet of heating surface and equipped for burning oil. The working pressure is 225 pounds per square inch.

The independent auxiliaries consist of a twin-beam air pump (8 inches by 10 inches), a vertical duplex main feed

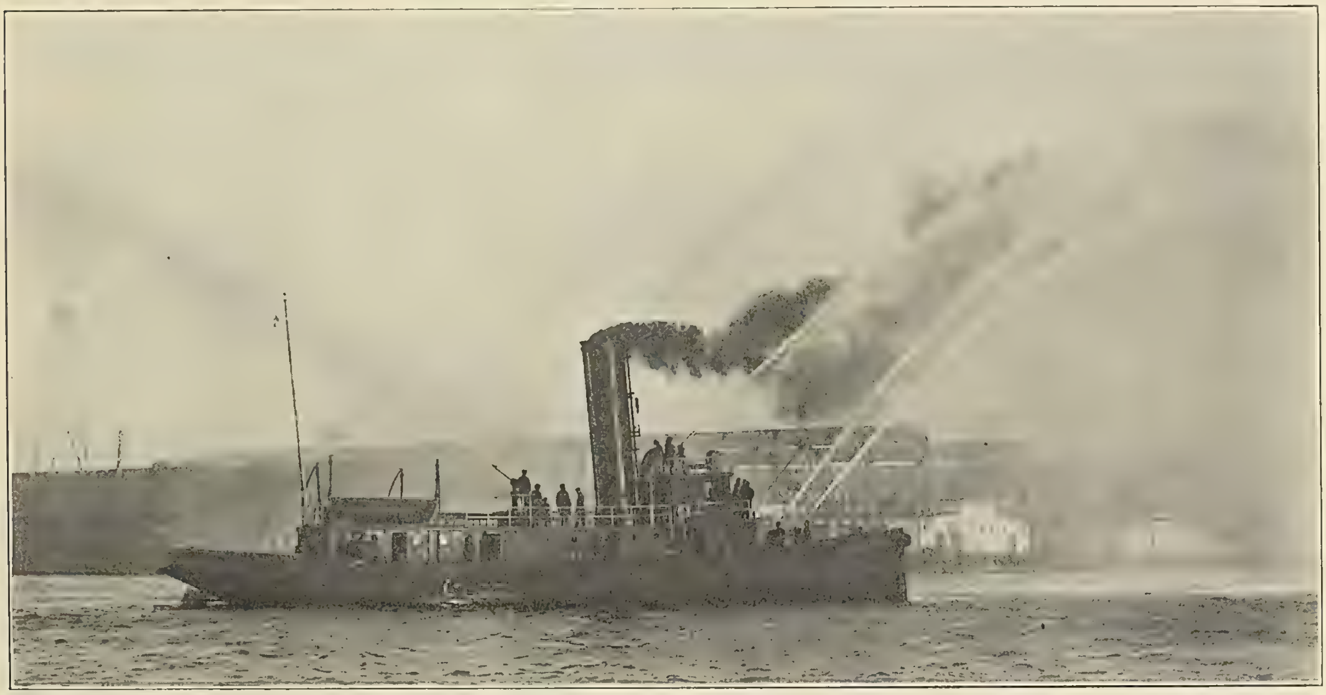
pump of the Admiralty pattern, 6 inches by 4 inches by 8 inches, a horizontal duplex donkey pump (7½ inches by 5 inches by 6 inches), a 7-inch centrifugal circulating pump driven by a 5-inch by 5-inch vertical engine, and two duplex oil-service pumps. The condenser is of the independent type with a cylindrical steel shell, and has 1,100 square feet of cooling surface. There is also a Reilly evaporator having a capacity of 1,500 gallons of feed water in twenty-four hours.

The propeller is a solid cast iron, four-bladed wheel, 8 feet 5 inches in diameter and 11 feet pitch.

The vessel's fire-fighting equipment consists of one vertical duplex fly-wheel pump of the George F. Blake manufacture, with two steam cylinders, each 17 inches in diameter, two water cylinders each 10 inches in diameter, with a common stroke of 11 inches, and a capacity of 3,000 gallons per minute. There are three monitor nozzles, each with a 3-inch stream, a 6-inch hose manifold located forward, and four hose connections distributed along the deck house.

The fire mains are built for a working pressure of 200 pounds per square inch; the pipes of large diameter being of cast iron, and the smaller ones of extra heavy wrought iron.

The maximum indicated horsepower of the main engines on trail was 840 and the corresponding speed 11 knots. The designed speed is 10 knots.



NEW BOSTON FIREBOAT, ENGINE 47, UNDERGOING TEST.

THE NEW BOSTON FIRE BOAT ENGINE 47.

Boston's new fireboat *Engine* 47, is one of the fastest, most powerful and efficient vessels ever built for fire service in America. Her charactertistic features were only adopted after a careful consideration of the needs of the water front of the city and a study of the latest types of such vessels built or building for other cities.

In Boston, the number of places demanding protection where the depth of water is limited requires a boat of light draft. The number of drawbridges that have to be passed through, and the presence of heavy ice in the winter season, necessitate a hull of substantial construction to withstand the severe service to which the boat must be subjected. It was with these conditions in mind that it was decided to build the hull of wood instead of steel. A wooden hull has greater local strength than the thinly plated steel vessel, making it much better adapted to withstand rough treatment at the drawbridges and wharves and in the ice. Being sheathed with copper over the whole immersed portion of the hull, it also keeps clean indefinitely, while a steel hull would soon foul up in the waters of the harbor. The life of a steel hull would also be very short in service as a Boston fireboat, for the reason that, in touching the first shoal place, the paint on the bottom would be scraped off and the erosive action of the sea water on the mild steel would be rapidly destructive.

The principal dimensions of the hull are as follows:

Length over all..................	113 feet 9 inches
Beam over plank	26 feet 0 inches
Depth	11 feet ½ inch
Draft, fully loaded..............	9 feet 0 inches

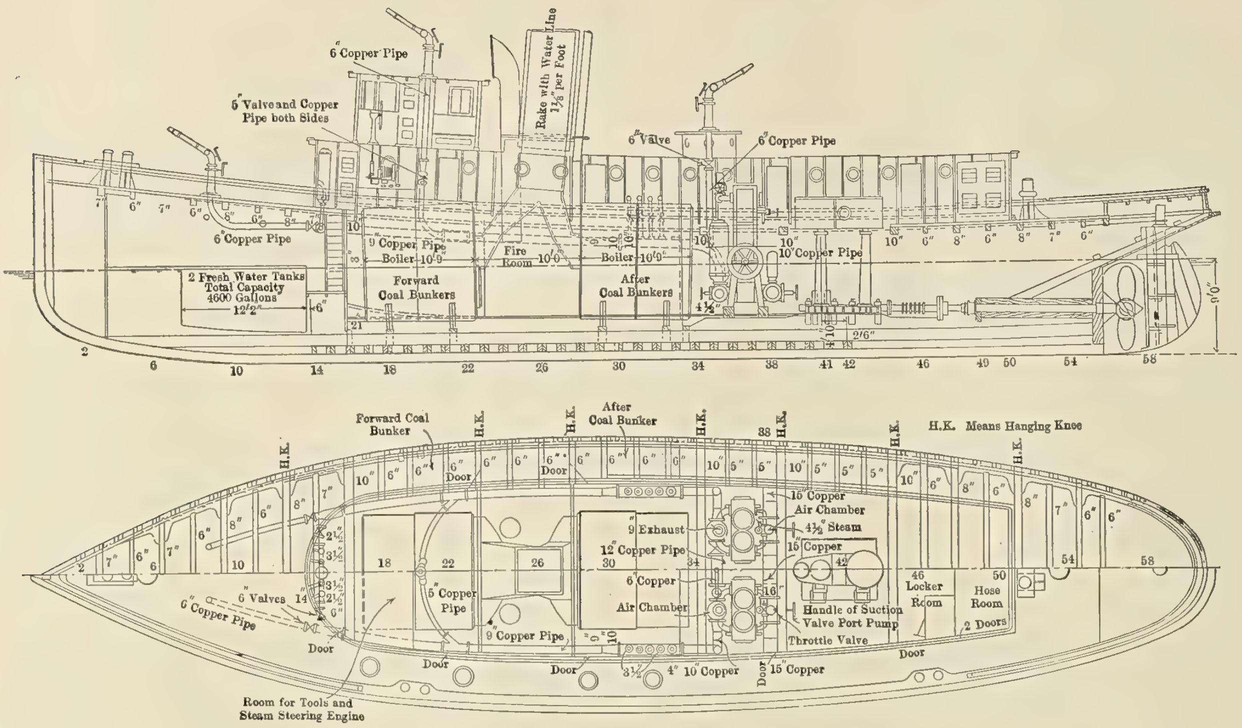
The keel, stem, propeller and rudder posts, rudder, outboard plank, frames, guards and rails are of white oak. The beams, keelsons, ceiling and clamps are of yellow pine, and the deck planks are of Oregon fir. The main deck house is of steel, and the pilot house of wood, the latter being thoroughly fitted with sprinkling arrangements piped to the fire-service pipe and fitted with valves for regulation. The entire bottom of the boat is sheathed with copper.

As the boat must operate on salt water and be independent of any fresh water supply for feeding boilers, the design of the machinery becomes much more complicated than for cities like Buffalo, Chicago and Detroit, where the feed water is pumped from the lake or river directly into the boilers and no condensing apparatus is necessary.

The new boat is as completely equipped with machinery as an ocean liner, as will be evident from the following condensed description:

The main engines are of the the vertical inverted compound type, high-pressure cylinder 17 inches diameter, low-pressure cylinder 36 inches diameter, the stroke of both being 24 inches. It is fitted with steam reversing gear.

The propeller is four-bladed, of the "built-up" type and is entirely of bronze. It is 8 feet diameter and 11 feet 6 inches pitch.



INBOARD PROFILE AND DECK PLAN OF THE BOSTON FIREBOAT.

The fire pumps, two in number, are of the vertical, tandem compound, duplex flywheel type. The steam cylinders are 12 and 22 inches in diameter, the water cylinders are 10 inches diameter, the stroke of all being 11 inches. They are designed for a combined capacity of 6,000 gallons of water per minute, with a pressure of 175 pounds per square inch at the pumps. In other words, the fire pumps can deliver 25 tons of water per minute at 175 pounds pressure.

One surface condenser is used for condensing all the exhaust steam, so that it may be pumped back into the boilers. There are a vertical twin air pump, a centrifugal circulating pump, two feed pumps, a bilge pump, two boiler circulating pumps and a sanitary pump.

There is an electric generating plant of 7½ kilowatts capacity, sufficient to thoroughly light the boat, and also furnish current for a powerful searchlight.

There is a steam steerer of the Hyde type, operated by a small hand wheel in the pilot house.

The boilers are of the Scotch type, two in number, 11 feet in diameter and 10 feet 9 inches long, built for a working pressure of 140 pounds per square inch. Each has two Morrison suspension furnaces 42 inches least internal diameter. The boilers are connected by breeching with a common double smokestack. Forced draft is provided by the closed ash-pit system, the blower being located in the fire room on the port side and discharging through ducts under the fire room floor into the furnaces below the grates. Dampers are provided for shutting the air off each furnace and for regulation.

There are twelve outlets for 3½-inch hose for use at fires some distance from the water front. Three thousand feet of hose are carried.

For fires on wharves or vessels, the boat is equipped with five swivel nozzles (or "guns," as they are called by the crew), two on the forward deck, one on the pilot house, one on the main deck house and one at the top of the smokestack. These are all worked by means of hand wheels, so that one man can easily handle one when working at any pressure.

The use of the smokestack as a water tower is unique, no other boat ever having been fitted up in this manner. It is expected to be particularly valuable for reaching fires by playing over buildings or high piles of lumber that could not be reached in any other way.

The boat was designed by William T. Keough, consulting engineer and naval architect, and has been built under the supervision of Superintendent Eugene M. Byington, of the Boston fire department repair shop.

The contractors for the hull and propelling machinery were the Bertelsen & Peterson Engineering Company, of East Boston, and the fire pumps were built by the George F. Blake Manufacturing Company, of East Cambridge.

At the recent large Lewis Wharf fire, the boat had the first chance to show her real worth. This fire started at night and had gained great headway among a lot of the most inflammable materials, such as resin, cotton, etc., before the alarm was given. The officers of *Engine* 47, with apparently unlimited confidence in the capacity and reliability of the boat, put her right into the slip on the leeward side of the fire and turned all five of the deck guns onto the burning warehouse. In the meantime the older boat (*Engine* 44) had attacked the fire from the other side of the pier. Their combined efforts were of such a high order that the fire, which had threatened to destroy the whole water front, was entirely confined to the pier upon which it started. Officials of the steamship companies who had seen the work of the new boat spoke with unstinted praise of her remarkable performance and the high efficiency of the department.

The Rivers and Harbors Bill, which has recently been reported to the United States Congress, carries an appropriation of $500,000 (£102,500) for experiments to improve the present type of river freight carriers. In connection with the proposed improvement of the upper Mississippi, it is now planned that tests shall be made by the government, with a view to developing a type of freight boat and towboat which will be able to handle commerce in water from 4 to 6 feet deep. If the experiments prove successful, it is expected that private capital will adopt the government's designs, and that there will be a marked increase in traffic on the shallow non-tidal rivers in the country.

THE MENACES OF THE SEA.*

The United States Revenue Cutter Service has been doing great work in removing derelicts and other menaces to navigation from the high seas. In many cases that have occurred during the past winter not only were very dangerous obstructions to commerce removed, but property of considerable value that had been absolutely given up as lost was restored to the owners. Three striking examples of the efficiency of this service have lately been recorded.

On January 25 the revenue cutter *Snohomish,* stationed at Neah Bay, Wash., discovered a derelict, which proved to be the *Susie M. Plummer,* off Cape Russell, near the northwest end of Vancouver Island. For two days during a southeast gale the *Snohomish* stood by the derelict, and finally on the third day, the sea and wind having moderated, the wreck was boarded and a line made fast to it. An attempt was made to tow the derelict into Puget Sound, where it was thought a portion of the cargo of lumber might be saved, but, on account of the heavy sea and the weight of the tow, the hawsers on the cutter could not stand the strain, and the derelict was eventually allowed to drift ashore in the vicinity of San Josef Bay, where she grounded on the rocks entirely out of the path of coasting vessels.

On February 8, 1910, the Dutch steamship *Prins Wilhelm III.* arrived in New York and reported having sighted at sea a derelict consisting of a floating vessel lumber laden, dismasted, waterlogged and abandoned. The news of the derelict was immediately transmitted to the revenue cutter *Seneca* at Tompkinsville, N. Y., and on the following day the *Seneca* left for the reported position of the wreck. Owing to unfavorable weather conditions, the derelict was not located until the morning of the 11th, when it was found somewhat to the southward and eastward of the originally reported location. Investigation proved that the derelict was the three-masted schooner *Sadie C. Sumner,* of Thomaston, Maine.; that the hold of the vessel contained a valuable cargo of cypress lumber, the deck load having been washed overboard, as was everything else above the main deck, and that the ground tackle and hull were in good condition, although the rudder stock had been carried away, rendering the rudder useless.

THE SADIE C. SUMNER WATERLOGGED AT SEA.

THE SUSIE M. PLUMMER, DERELICT OFF CAPE RUSSELL, VANCOUVER ISLAND.

THE FOUR-MASTED SCHOONER ASBURY FOUNTAIN.

The *Seneca* took the derelict in tow and immediately started for the Virginia capes, but at night a northeast gale sprang up, making progress, which under the most favorable weather conditions was slow and arduous, entirely impossible, so the *Seneca* hove to, leading the tow lines from her forward chocks

* By courtesy of The Army and Navy Register.

and utilizing the wreck as a sea anchor. During the night, however, both tow lines parted, and the derelict was again adrift on the sea until after the gale abated on the 13th, when the *Seneca* recovered her prize, and, taking it in tow, headed in again for Chesapeake Bay.

After this, on two different occasions the wreck, being heavy and cumbersome on account of her waterlogged condition, parted the lines of the revenue cutter, but finally on the night of the 15th the *Seneca* stood into Hampton Roads and anchored the derelict under Sewall Point.

On March 3, 1910, while standing up the coast bound for Chesapeake Bay, the steamship *Jamestown*, of the Clyde Line, collided with the four-masted schooner *Asbury Fountain*, of New York, and damaged her so badly that her crew were forced to immediately abandon her. The crew of the *Fountain* were taken off their sinking vessel by the *Jamestown* and transported to Norfolk, but the ill-fated schooner was left adrift on the high seas, a floating derelict in the path of all vessels bound in or out of Chesapeake Bay.

The news of the accident and the existence of this huge derelict was immediately transmitted to the Revenue Cutter Service at Washington, and on the afternoon of that day the revenue cutter *Onondaga*, under wirelss orders from the Department, left Norfolk in search of this menace to navigation. The *Fountain* was found on the morning of March 5 in a position fifteen miles south-southwest from *Winter Quarter Shoal* lightship, and preparations were immediately made for towing the derelict to port. The bow had been stove in and the schooner appeared to be anchored to the bottom by wreckage from her foremast and bowsprit, and on account of her injuries it was necessary to tow the wreck stern foremost.

In this manner the tow proceeded toward Hampton Roads, but, on account of the mass of wreckage over the bow and the difficulty experienced in steering the derelict, little progress was made. On the afternoon of the 5th the *Mohawk* arrived on the scene, having been sent out from New York to search for the derelict, and having picked up the wireless calls of the *Onondaga* for assistance. The *Mohawk* ran a hawser from her bow to the mainmast of the schooner, and by skillful maneuvering was able to successfully steer the *Fountain* and materially increased the speed of the tow. To facilitate the handling of the tow, a mine was exploded under the bow of the derelict, clearing away a quantity of the wreckage which had impeded the efforts of the cutters.

On the following day, March 6, the two cutters passed slowly in through the entrance of Chesapeake Bay and beached the big derelict on the flats near the mouth of the Elizabeth River, when it was identified and taken possession of by the owners.

THE BATTLESHIP OF THE FUTURE.*

BY REAR ADMIRAL R. H. S. BACON, C. V. O., D. S. O.

In these days the battleship has developed merely into a vessel for fighting other battleships, and it shuns as far as possible encounters with most other classes of vessels, and it is particularly vulnerable to torpedo attack. The problem of building a ship which cannot be sunk by the explosion of a torpedo, or which will not be incapacitated by torpedo attack, has heretofore baffled all solution.

The modern battleship is solely a gun platform. The gun is at the present moment the main weapon in deciding naval actions, therefore progress in battleship design has continually been in the direction of increased offensive gun power and defensive armor protection against gun power. So much has the power and accuracy of modern guns been improved that the accuracy of the gun to-day at 12,000 yards is considerably greater than the accuracy of the gun of thirty years ago at 2,000 yards. At the present moment the development of the gun shows no reason for abating, and there is every reason to believe that, if required, the power of the gun can, within the next few years, be considerably increased. Whether or not such an increase is desirable depends somewhat upon another factor in battleship design, namely: its defensive armor.

In the battleship, speed is sacrificed to armor protection, but there is no doubt that the gun of the present day, with armor-piercing projectiles, at a range of about 6,000 yards can penetrate any armor which can be practically mounted in a ship, and guns can be built which can penetrate this armor at ranges outside which it would be practically impossible to bring a fleet action to a decisive conclusion. It is, therefore, perfectly hopeless to think of attempting to supply armor which would be impenetrable to guns which may be constructed in the reasonable future.

As far as increasing the size of guns is concerned, there is no immediate necessity for increasing the power of the gun in order to perforate the present-day armor, but the armor-piercing projectile is not the most efficient shell for effecting general damage on a ship, and penetration of armor is not the sole object of gun fire. The chief damage will probably be done by heavy bursting charges and, other things being equal, the larger the gun the larger the projectile, and the better the result from this point of view. An increase in the size of guns, however, can only be made at the expense of either the number of guns carried, the armor protection or a reduction in speed. Closely related to this question is the question of increase in displacement. This is a question which must be settled largely from the point of view of expense, expediency, efficiency and general utility. The main arguments against increase in size are the enormous cost of each ship and, therefore, the large loss in case of sinking, and the inadequacy of present harbor facilities and docks. There seems to be no doubt that the larger the ship the more likely she is to survive the blow of a torpedo. Surviving, however, is not the sole point. Damage by a torpedo will temporarily incapacitate a ship however large she may be, and therefore a bigger money value of fighting appliance will be temporarily incapacitated by a single torpedo attack in the case of the large ship than in the case of the smaller, but, whereas the damage may be repaired in the large ship, the smaller ship may sink, and the loss thus become permanent. The question of cost is likely to be one of the deciding features in the increased size of warships.

The abolition of the secondary armament in a modern battleship has tended to improve the accuracy of hitting of the heavier guns, and has also caused a saving in weight which can be utilized for other purposes. If it were possible to install 6-inch guns in a ship without either restricting the fire of the heavier guns or unnecessarily increasing her displacement, and if it were thoroughly understood that they were only there to be used in thick weather, there might be some advantage in installing them. The difficulty, however, of such an installation is very great. If placed below the tier of heavy guns their position comes very close to the water. If placed on a level with the heavier guns they are bound to reduce the arc of fire of the 12-inch guns, and if placed above them they involve considerable top weight, since they are useless unless properly protected with armor. Up to the present, those responsible for the construction of British ships appear to take the point of view that the advantage of the intermediate caliber is not worth the extra displacement. Considering 6-inch guns solely from the point of view of defense against torpedo-boat attack, there is good excuse for considering this, since anti-torpedo guns require no armor protection. If, however, 6-inch guns should be used for anti-torpedo boat guns, instead of 4-inch, they would set a low limit on the

* From a paper read before the Institution of Naval Architects, London, March, 1910.

thickness of armor belt, since it would obviously be foolish to reduce this to an amount which would allow these small guns to effect penetration at battle ranges, and, therefore, to allow the ship to be open to vital attack by small guns.

There is no difficulty in handling and maneuvering the large battleships in company with smaller vessels.

Recent improvements in torpedoes make this weapon an extremely powerful factor in modern naval warfare, and, as seems likely, if the range of the torpedo can be brought up to 6,000 yards, it will be a still more important factor.

The third possibility of saving weight is a reduction in speed. The recent increase in speed in battleships has been severely attacked from a technical point of view, although it is greatly appreciated from a strategical point of view. Judging from past experience, however, it is improbable that the designed speed of modern ships will be reduced. Due to the improvements in the torpedo, there will in time be introduced a class of tactics more analogous to a single ship than fleet actions. It is in such a class of tactics that speed will become a valuable factor, and it is highly probable that the speed of battleships will increase up to that of cruisers.

All the considerations of offense and defense point to increase in size of battleships as modern gun construction advances. But since the modern battleship no longer holds the supreme position which in the old days made the battleship the sole ultimate arbiter of sea power, it is improbable that as the torpedo improves, battleships, unable to defend themselves against any form of torpedo craft, will be built merely to fight battleships. The functions of the large cruiser will, therefore, be assumed by the battleship, high speed will become more and more necessary, and armor protection will be less accentuated than at present. The link between the ocean-going destroyer and the battleship will become closer, and we may reasonably expect that the monsters of the future will always be accompanied by torpedo craft of high sea-going speed as defensive and offensive satellites.

The battleship as now known will probably develop from a single ship into a battle unit consisting of a large armored cruiser with attendant torpedo craft. Line of battle as we now know it will be radically modified, and the fleet action of the future will in the course of time develop into an aggregation of duels between opposing units. The tactics of such units open up a vista of most exhilarating speculation and will afford to the naval officer of the future a scope for his tactical skill never dreamed of by us or our predecessors.

The whole future is pregnant with radical obliteration of our present opinions as regards tactics, but we may confidently prophesy that size of ships and power of gun will increase and increase until war, the great arbitrator among theories, will reform or reconstitute our opinions regarding naval armaments.

MECHANICAL GEARING FOR MARINE TURBINES.

The Application of the Marine Steam Turbine and Mechanical Gearing to Merchant Ships.*

BY HON. C. A. PARSONS, C. B., F. R. S., D. SC.

The steam turbine has not as yet been applied to vessels of slow, normal speed on account of the high initial cost and inferior economy in steam; further, no promising scheme has as yet been evolved having for its object the modification of the turbine or propeller, so as to reduce the efficient speed of revolution of the former and increase that of the latter for vessels of 12 knots sea speed and under; and the only approach of meeting these conditions (if we except gearing propositions) has been in the combination system, where the turbine plays a secondary part in the equipment by utilizing the lower portion of the expansion of the steam between the low-pressure cylinder of the reciprocating engine and the condenser. This system was fully explained in the paper by Mr. Walker and myself at the meeting of this institution in March, 1908.

The complete and most satisfactory solution for slow-speed vessels would appear to be by means of gearing, provided the losses in transmission, first cost, and cost of maintenance are not too great. Many forms of gearing—mechanical, electrical and hydraulic—have been proposed or applied on a small scale.

I believe the first application of helical spur gearing to drive a propeller was made by the Parsons Marine Steam Turbine Company, Ltd., in 1897. The turbine was of 10 horsepower, geared to two wheels, each wheel driving a propeller shaft. The revolutions of the propellers were 1,400 per minute, and the ratio of the gear 14 to 1. The turbine was of the Parsons type, with a reversing turbine on the same shaft, incorporated in the same casing. The gear was single helical. The turbine took part of the thrust of the propeller, the remaining thrust being taken on the thrust-bearing in the gear casing. The air, circulating, and oil pumps were driven by worm gearing off one of the screw shafts. The launch was 22 feet over all, and attained a speed of 9 miles an hour. This launch was built to the order of Mr. F. B. Atkinson, for his yacht *Charmian*. The launch was sent to the Turbinia Works in 1904, and the turbine was generally overhauled and cleaned. The gear was found to be in perfect order, and did not require any repair. Helical and double-helical gear of fine pitch, suited to high speeds of rotation was, I believe, first introduced by Dr. De Laval, of Stockholm, and has been extensively used in connection with this turbine for many years with entire success and at a moderate cost of maintenance. I have had several experimental sets constructed. One of these

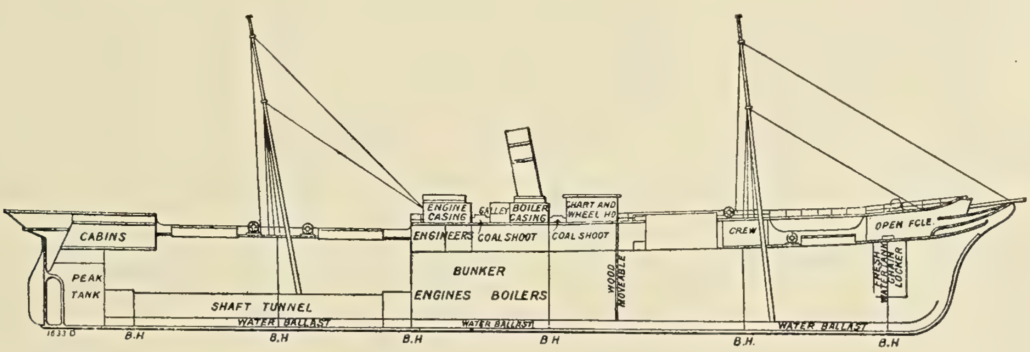


FIG. 1.

* From a paper read before the Institution of Naval Architects, London, March, 1910.

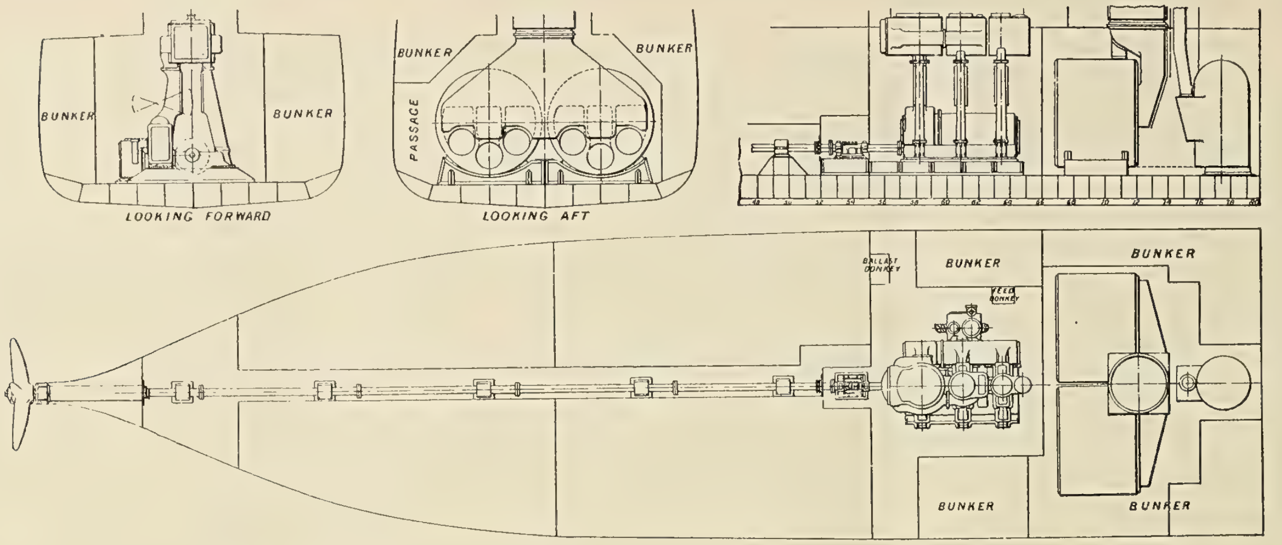


FIG. 2.—GENERAL ARRANGEMENT OF RECIPROCATING ENGINES AND BOILERS IN S. S. VESPASIAN.

was a double-helical gear of the De Laval type, made in 1897, gearing from 9,600 revolutions of the turbine to 4,800 of the dynamo, transmitting 300 horsepower. The efficiency was estimated by the method of heat loss to be above 98 percent. This gear was cut in an ordinary universal milling machine without any special precaution as to accuracy, and I was much impressed (in spite of the obvious irregularity of the teeth) by finding how well it ran, except that it made a considerable noise.

Gears that have been recently cut by the Power Plant Company and by special machinery run with very little noise. A recent experimental set of gearing cut by Messrs. D. Brown, of Huddersfield, for a speed reduction from 2,000 to 400 revolutions, transmitting 300 horsepower, according to a Heenan-Froude water-braked dynamo meter, has a total loss in the gear case, including friction of gear and bearings, of 1½ percent.

In the summer of last year the directors of the Turbinia Works Company decided to test turbines mechanically geared to the screw-shaft of an existing typical slow-speed vessel, and a cargo vessel, named the *Vespasian,* was purchased for this purpose. The *Vespasian* was built in 1887 by Messrs. Short Brothers, of Sunderland. Her dimensions are: Length on load-waterline, 275 feet; breadth, molded, 38 feet 9 inches; depth, molded, 21 feet 2 inches; mean loaded draft, 19 feet 8 inches; and displacement, 4,350 tons.

The vessel had originally an ordinary triple-expansion surface condensing engine, by Mr. G. Clark, of Sunderland, with cylinders 22¼ inches, 35 inches and 59 inches in diameter by 42-inch stroke. The air, circulating, feed and bilge pumps were driven from the intermediate-pressure crosshead with the usual arrangement of levers and links. The condenser was cast with the back columns of the main engine, and had a cooling surface of 1,770 square feet. The boilers—two in number—are 13 feet in diameter by 10 feet 6 inches long, with a total heating surface of 3,430 square feet, and grate area of 98 square feet, working under a pressure of 150 pounds, with natural draft. The propeller is of cast iron, and has four blades, having a diameter of 14 feet, a pitch of 16.35 feet and an expanded area of 70 square feet.

With a view to obtaining comparative data between the turbine installation and the reciprocating engine, it was decided to

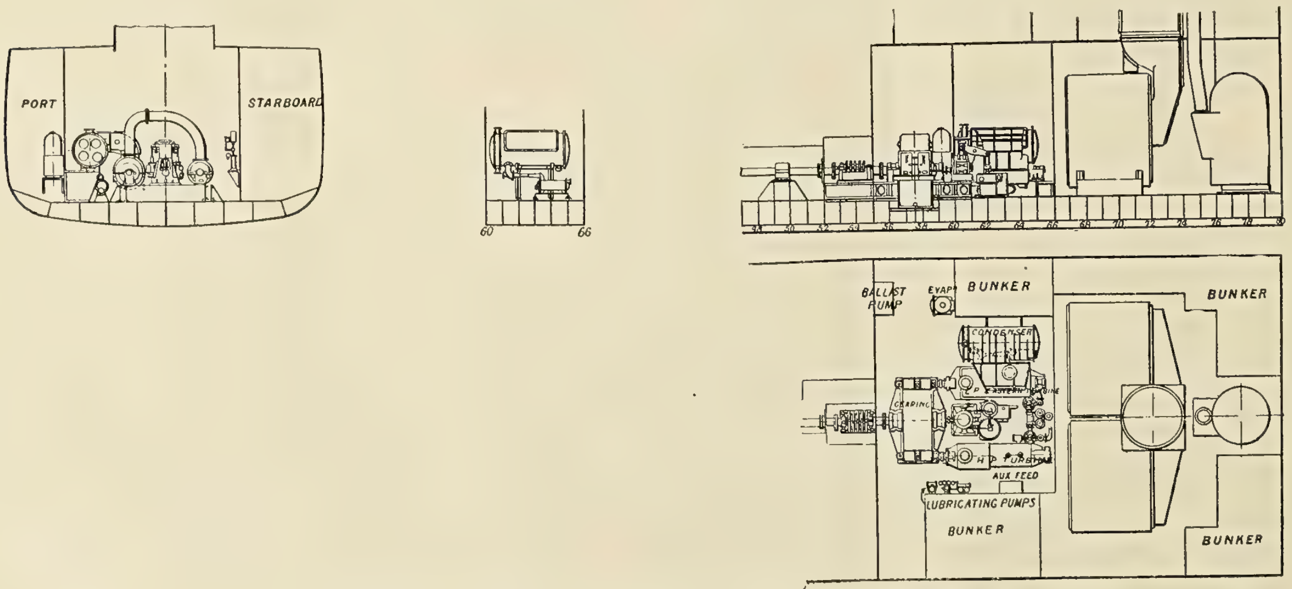


FIG. 3.—GENERAL ARRANGEMENT OF TURBINES AND GEARING IN S. S. VESPASIAN.

run trials with the vessel with her reciprocating engine previous to its removal, and the installing of the turbines and gearing.

Fig. 1 shows a profile of the vessel, and Fig. 2 a general arrangement of the reciprocating engine and boilers.

Before proceeding on the voyage upon which data regarding the performance of the reciprocating engine were taken, the propelling machinery was completely dismantled and overhauled. The high-pressure piston valve chamber was rebored and new valve rings fitted; slide valves were replaned and faced up; bearings were renewed, and other repairs carried out wherever necessary to bring the machinery into an efficient condition and first-class working order. To obtain reliable

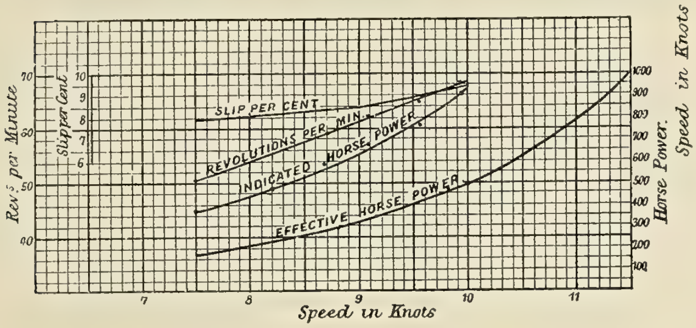


FIG. 4.

measurements of water consumption, two tanks were fitted, each of 400 gallons capacity, with suitable change cocks and connections for the air pump to discharge through these measuring tanks.

It was necessary, for the purpose of obtaining data under service conditions, that the vessel should be run at her loaded condition. Arrangements were consequently made with a firm of shipbrokers to take a cargo of coal from the Tyne to Malta, and on June 26, last year, the *Vespasian* left the Tyne, in a loaded condition, with a special recording staff on board, and on this voyage careful measurements of coal and water consumption were made.

The data and results of a progressive trial carried out on the Whitley Bay mile are given in Table 1, from which, together with the data taken on the voyage referred to, the curves in Figs. 4 to 7 and 9 have been plotted.

Fig. 4 (full lines) shows the results of the progressive trial to a basis of speed of vessel. The effective horsepower shown

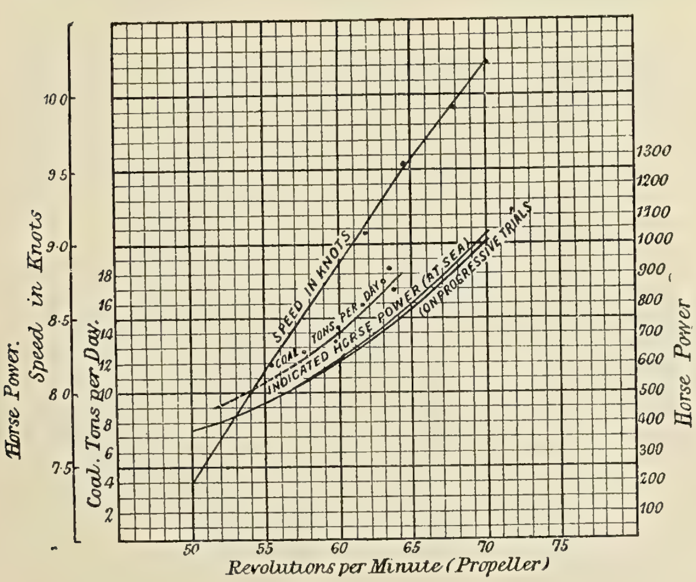


FIG. 5.

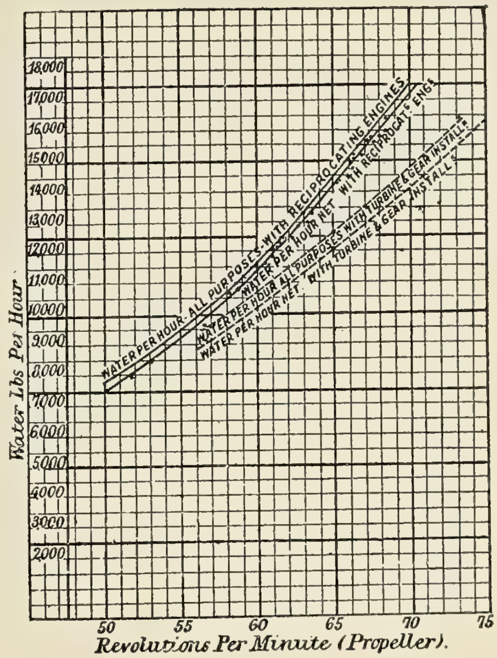


FIG. 6.

on this diagram is calculated from the resistance as obtained from a model experiement of the vessel to a scale of 3/8 inch to the foot.

Fig. 5 (full lines) shows the results as obtained on the voyage, plotted to a basis of revolution. For the sake of comparison, the indicated horsepower taken on the progressive trial is also shown, together with the speed corresponding to revolutions taken on the measured mile.

Fig. 6 (full lines) shows the water consumption per hour for main engines only and for all purposes to a basis of revolutions. The difference between these two curves represents the

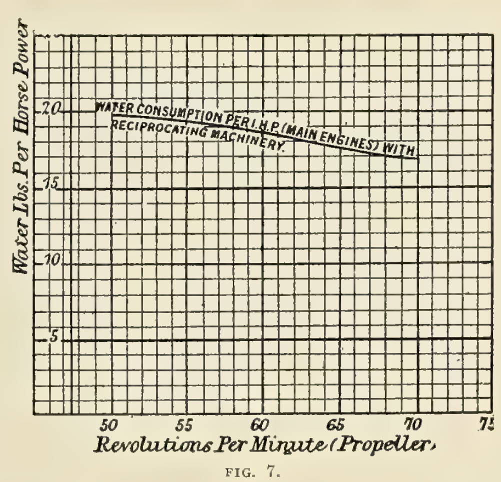


FIG. 7.

consumption of steam of steering engine, the exhaust of which was led to a separate measuring tank.

Fig. 7 shows the water per indicated horsepower also plotted to a basis of revolutions.

Fig. 9 shows the propulsive coefficient plotted to a basis of speed.

On the completion of the voyage, the vessel returned to the Turbinia Works, where her reciproating engine was taken out, engine seats remodeled and preparation made for the reception of the tubines and gearing.

Fig. 3 shows the general arrangement of the turbine machinery and gearing.

The only alteration made to the vessel was in the type of

propelling engines; the boilers, propeller, shafting and thrust blocks remained the same as for the reciprocating engine.

The propelling machinery consists of two turbines in "series," viz.: one high-pressure and one low-pressure, the high-pressure turbine being placed on the starboard side of the vessel and the low-pressure on the port side. At the after end of each of the turbines a driving pinion is connected with a flexible coupling between the pinion shaft and the turbine, the

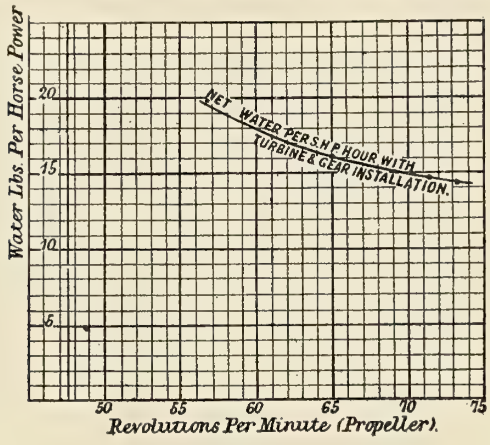


FIG. 8.

pinion on each side of the vessel being geared into a wheel, which is coupled to the propeller shaft.

A reversing turbine is incorporated in the exhaust casing of the low-pressure turbine. The air, circulating, feed and bilge-pumps are of the usual design for tramp steamers, and are driven by means of a crank and connecting-rod coupled to the forward end of the gear-wheel shaft. The turbine and pinion-shaft bearings are under forced lubrication, as in ordinary turbine practice. The teeth of the pinions and of the gear-wheel are lubricated by means of a "spray" pipe extending the full width of the face of the wheel. Independent oil-pumps are fitted for supplying oil to the bearings and gear-

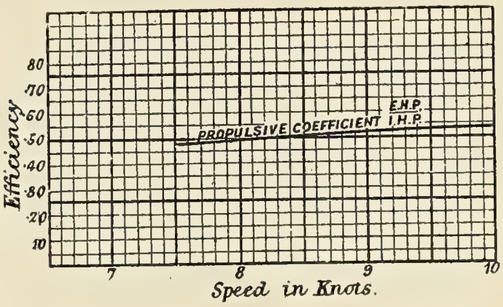


FIG. 9.

wheel. With a view to the possibility of experimenting with different lubricants for the gear-wheel, the oiling system for the bearings is separate from that of the gear-wheel.

The high-pressure turbine is 3 feet maximum diameter by 13 feet over-all length, and the low-pressure 3 feet 10 inches in diameter by 12 feet 6 inches length. The turbines are similar in design to a land turbine, being balanced for steam thrust only, the propeller thrust being taken up by the ordinary thrust-block of the horse-shoe type, which is fitted aft of the gear-wheel. A new condenser, together with a vacuum augmentor, is fitted with the turbine installation. The cooling surface of the condenser is 1,165 square feet.

The gear-wheel is of cast iron, with two forged steel rims shrunk on. The diameter of the wheel is 8 feet 3½ inches pitch circle, having 398 teeth—double helical—with a circular pitch of 0.7854 inch. The total width of the face of the wheel is 24 inches; the inclination of teeth 20 degrees to the axis.

The pinion shafts are of chrome nickel steel, 5 inches in diameter pitch circle, with 20 teeth 0.7854 circular pitch. The ratio of gear is 19.9 to 1.

On the completion of the erection, on board, of the turbine-gearing installation at the end of February of this year, the vessel was loaded to the same draft and displacement as that under which the trials referred to in Table I. were run. As already mentioned, the propeller has not been touched or altered in any way. In the short interval since the completion of her alterations, the vessel has been out to sea on four occasions.

Table II. gives the data and results of a run made off the Tyne on 11th of this month:

TABLE 1.—S. S. VESPASIAN. PROGRESSIVE TRIAL ON HARTLEY MILE, WITH RECIPROCATING ENGINES.

Direction of run	S.	N.	Mean.	S.	N.	Mean.
Speed	7.438	7.563	7.50	8.531	7.860	8.195
Revolutions per minute	49.9	51.27	50.58	55.1	55.5	55.3
Boiler pressure in pounds	126	130	128	138	129	133.5
H. P. receiver pressure	73	72	72.5	82	84	83
I. P. receiver pressure	17.5	17.25	17.37	20.5	22	21.25
L. P. receiver pressure	—4.75	—6	—5.37	—4.5	—4.75	—4.62
L. P. exhaust pressure. in.	27	27	27	27	27	27
Vacuum in.	28.25	28.37	28.31	28.5	28.5	28.5
Barometer in.	29.96	......	......	......	......	......
Mean H. P. pressure	30.75	30.35	30.55	34.25	34.85	34.55
Mean I. P. pressure	13.8	13.85	13.82	14.8	14.6	14.70
Mean L. P. pressure	3.91	4.125	4.01	4.8	4.87	4.83
I H. P., H. P.	124	126	125	152.5	156.5	154.5
I. H. P., I. P.	139	143.5	141.2	164.5	164	164.2
I. H. P., L. P.	113	122	117.5	153	156.5	154.7
I. H. P., total	376	391.5	383.7	470	477	473.5
Temp. circ. inlet	55.5	......	......	......	......	......
Temp. circ. disc	76	81	78.5	87	87	87
Temp. hotwell	73	71	72	81	85	83
Direction of run	S.	N.	Mean.	S.	N.	Mean.
Speed	9.278	8.090	8.684	11.009	9.399	10.204
Revolutions per minute	58.4	59.3	58.85	70	70.1	70.05
Boiler pressure in pounds	135	143	139	152	149	150.5
H. P. receiver pressure	95	95	95	128.5	127.5	128
I. P. receiver pressure	26	26	26	44	45	44.5
L. P. receiver pressure	—3.37	—2.75	—3.06	3	3.62	3.31
L. P. exhaust pressure. in.	26.8	26.8	26.8	25.2	25.2	25.2
Vacuum in.	28.25	28.25	28.25	26.5	26.5	26.5
Barometer in.	......	......	......	......	......	......
Mean H. P. Pressure	37.3	38.15	37.72	47.6	47.95	47.77
Mean I. P. pressure	17.25	17.45	17.35	24.8	24.65	24.72
Mean L. P. pressure	5.61	5.91	5.76	8.86	9.51	9.18
I. H. P., H. P.	176	183	179.5	269	272	270.5
I. H. P., I. P.	204	209	206.5	351	348	349.5
I. H. P., L. P.	189.5	203	196.2	359	387	373
I. H. P., total	569.5	595	582.2	979	1007	993
Temp. circ. inlet	......	......	......	......	......	......
Temp. circ. disc	91	90	90.5	106	107	106.5
Temp. hotwell	91	92	91.5	118	119	118.5
Direction of run	S.	N.	Mean.	S.	N.	Mean.
Speed	10.778	9.068	9.923	10.315	8.759	9.537
Revolutions per minute	67.4	68.27	67.83	64.9	64.36	64.63
Boiler pressure in pounds	142.5	130	136.2	143	132	137.5
H. P. receiver pressure	120.5	115	117.75	113	107	110
I. P. receiver pressure	40	42	41	36.5	35.5	36
L. P. receiver pressure	1.5	2.75	2.12	—.75	—1	—.875
L. P. exhaust pressure. in.	25.75	25.5	25.62	26.2	26	26.1
Vacuum in.	27.25	26.87	27.06	27.67	27.37	27.52
Barometer in.	......	......	......	......	......	......
Mean H. P. pressure	44.12	43	43.56	41.85	42.25	42.05
Mean I. P. pressure	23.2	24.67	23.93	21.7	22	21.85
Mean L. P. pressure	8.42	8.8	8.61	7.18	6.96	7.07
I. H. P., H. P.	241	237.5	239.2	220	220	220
I. H. P., I. P.	316	340.5	328.2	284.5	286	285.2
I. H. P., L. P.	328.5	344	336.2	269.5	259	264.2
I. H. P., total	885.5	922	903.7	774	765	769.5
Temp. circ. inlet	......	......	......	......	......	......
Temp. circ. disc	101	104	102.5	97	98	97.5
Temp. hotwell	112	116	114	98	101	99.5
Direction of run	S.	N.	Mean.	N.	S.	Mean.
Speed	9.809	8.824	9.316	8.824	9.326	9.075
Revolutions per minute	62	62.1	62.05	62.1	61.3	61.7
Boiler pressure in pounds	128	128	128	128	120	124
H. P. receiver pressure	101	102	101.5	102	100	101
I. P. receiver pressure	31	30.5	30.75	30.5	32	31.25
L. P. receiver pressure	—1.5	—1.5	—1.5	—1.5	—2.5	—2
L, P, exhaust pressure. in.	26.25	26.25	26.25	26.25	26.25	26.25
Vacuum in.	27.5	27.75	27.62	27.75	27.67	27.71
Barometer in.	......	......	......	......	......	......
Mean H. P. pressure	39.3	40.5	39.9	40.5	40.5	40.5
Mean I. P. pressure	20.25	19.7	19.97	19.7	20.55	20.12
Mean L. P. pressure	6.32	6.5	6.41	6.5	5.83	6.16
I. H. P., H. P.	197.5	203.5	200.5	203.5	201	202.2
I. H. P., I. P.	253.5	247	250.2	247	254.5	250.7
I. H. P., L. P.	227	233.5	230.2	233.5	206.5	220
I. H. P., total	678	684	681	684	662	673
Temp. circ. inlet	......	......	......	......	......	......
Temp. circ. disc	94.5	94	94.2	94	94	94
Temp. hotwell	94	93	93.5	93	94	93.5

Draft taken at Whitley Bay. Draft, forward, 19 ft. 1 in.; draft, aft, 20 ft. 3 in.; draft, mean, 19 ft. 8 in. Dimensions, molded, 275 ft. by 38.75 ft. by 21.16 ft. Displacement 4350 tons; coefficient, 0.754. Propeller, solid cast iron, four blades; diameter, 14 ft.; pitch, 16.35 ft.; expanded area, 10,100 sq. in. Measured mile at Hartley. High-pressure cylinder—diameter 22¼ in.; mean cut-off, 71 percent; intermediate cylinder-diameter, 35 in.; mean cut-off, 63 percent; low-pressure cylinder-diameter, 59 in.; mean cut-off, 64 percent; stroke, 42 in.

The water consumptions per hour at the several rates of revolutions have been plotted in Fig. 6, shown in full lines for the reciprocating engines, and in dotted lines for the turbine-geared engines. It will be noted that under normal full-speed steaming conditions an increase of about 1 knot is obtained with the same coal consumption. Fig. 8 shows the water consumption per shaft horsepower for the geared turbines.

TABLE II.—TRIALS WITH TUBINES AND GEARING.

Speeds in knots	8.4	9.56	10.5	10.66
Revolutions per minute	56.5	65	71.3	73.3
Boiler pressure, lb.	145	144	140	145
Initial pressure, high-pressure turbine, lb.	60	86	110	121
Initial pressure, low-pressure turbine, lb.	15.2	12.5	7.1	5.5
Vacuum, in.	28.8	28.8	28.7	28.5
Barometer, in.	29.9	......	......	......
Shaft horsepower	456	740	980	1095
Water consumption per hour, main engines, lb	9070	12,000	14,480	15,670
Water consumption per hour, all purposes, lb.	9670	12,620	15,120	16,370
Water consumption per shaft horsepower per hour, main engines, lb.	19.8	16.2	14.8	14.3

It will be noted that the observed mean speeds on the measured mile, given in Table II., correspond to the speeds obtained with the reciprocating engines at the same revolutions in Table I., thus eliminating any necessity for allowances, the weather conditions in the two cases being very similar. It may be mentioned that the turbines and gearing have given no trouble, and have worked satisfactorily with very little noise or vibration throughout the trials. Further, there is no appreciable wear on the teeth or bearings. It is proposed to put the vessel into commission and run extended trials.

THE MARINE STEAM ENGINE INDICATOR—XI.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

PRELIMINARY TESTS.

The indicator and necessary engine attachment being provided, the preliminary tests, which should be made before taking diagrams, will now be considered. From the scrap on board select any piece of metal of sufficient size for the purpose and drill and tap it to suit the thread on the straightway cocks (Fig. 44, January, 1910), which should be provided with every indicator intended for marine use. If a suitable piece of metal cannot be found any threaded pipe fitting will do provided the thread is of the proper size. Screw the indicator cock into the fitting and secure the fitting in a bench vise, so that the axis of the cock will stand vertical. The indicator may now be attached to the cock in the usual manner. This is a convenient way to hold the instrument while making some of the tests to be described. The indicator itself should never be clamped in a vise.

Having secured the instrument in a handy location, fit a stiff spring to the piston and cover and examine for lost motion by trying to move the pencil in various directions in a vertical plane. When the piston-rod guide forms an essential part of the parallel motion this should be examined with particular care. The mechanism should be gone over until there is no unrestrained movement at the pencil. All lost motion having been taken up in the pencil mechanism, the swivel head, which carries the entire mechanism, should be tried for slackness where it bears on the frame of the instrument. The moving parts should now be tested for friction as follows: Remove the spring and piston, raise the pencil to its highest working position, and let go. It should fall instantly to its lowest position. Attach the piston—without the spring—and work the pencil lever slowly and carefully up and down, feeling all the while for any suspicion of a "catch" or binding. If any sticking is detected its cause must be ascertained and removed before going further. A slight roughness in the cylinder or on the surface of the piston may sometimes be corrected by polishing with the finger end covered with rotten stone and oil, or with any of the fine red polishing pastes made of crocus. With the piston still in place on the rod, raise the pencil to its full working height and close the cock on the steam inlet. The pencil should remain at the top of its stroke or sink very slowly. On opening the cock with the piston at any point the pencil should drop instantly to its lowest designed position. It is not at all essential that the piston should be absolutely tight, but it should be tight enough to prevent the pencil falling quickly when the steam inlet is closed. If the instrument will not pass these friction tests, after carefully taking up all lost motion, it should be sent to the maker for overhauling, and if the instrument is a new one, it should be rejected and another required.

In order that the pencil may bear on the card with constant pressure at all points it is necessary that the drum be truly round and accurately centered. It is also essential that the drum axis be parallel with the plane in which the pencil moves. These conditions are tested for as follows: Remove the piston spring, but leave the piston attached to the rod. Adjust the stop on the swivel head, so that "day light" is just visible between the pencil point and the drum surface. Using a lead pencil or soft-wood stick from below, push the piston slowly upwards through its full travel, sighting all the time between the drum and pencil point. If the distance changes in the slightest degree, either the drum axis or pencil mechanism is out of line. The drum should next be rotated by pulling on the cord. If there is any change in the space during this operation the drum is either "out of round" or improperly centered. These tests should be repeated with the drum in various positions and the pencil at different heights. If the drum is not true, remove it from the base ring, clean the seating and replace. If it cannot be made to run true after cleaning and reseating it should be returned to the factory for correction. If used with the drum in bad condition the pencil will drag in spots and throw the diagram out.

The vertical and horizontal lines drawn by the instrument must be straight and "square" with each other. Put a paper card on the drum; adjust the stop so that the pencil point will just touch the paper. Push the piston up—as before described—drawing a vertical line. Fit a piston spring to the instrument and draw a fine horizontal line by pulling on the cord. If the lines thus drawn are not straight, or if they do not make an angle of 90 degrees, either the pencil motion is incorrect or the drum may have a slight vertical movement on its stem. The squareness of the lines may be tested in several ways, but the most accurate and convenient method is probably as follows: In Fig. 82 let x x and y y be the test lines drawn by the indicator, and let O denote the point of intersection. With O as a center and a radius equal (roughly) to three-fourths of O y, describe the arc ABC. With the same radius and with B as a center describe the arc DOY. B should be so located on ABC that it will cut x x at an angle of about 45 degrees. With an accurate straight edge pass a line through D and B, and produce it to cut y y, as shown. If the test lines are square, y y, DBY and the arc DOY will cross each other at the same point.[1]

[1] By Geometry: "An inscribed angle is measured by one-half its intercepted arc," and in consequence "an angle inscribed in a semi-circle is a right angle."

If the vertical line crosses at any other point—as at *Z*—the test lines are out. This checking should be done with sharp pencils and compass points and an accurate straight edge. The ordinary triangles or set squares used by draftsmen should not be used—unless they have been tested and are known to be correct—for the reason that those made of wood, celluloid and even of hard rubber change their shape when a few months old. Metal squares are, of course, not open to this objection.

The indicator should now be tested for correct proportional

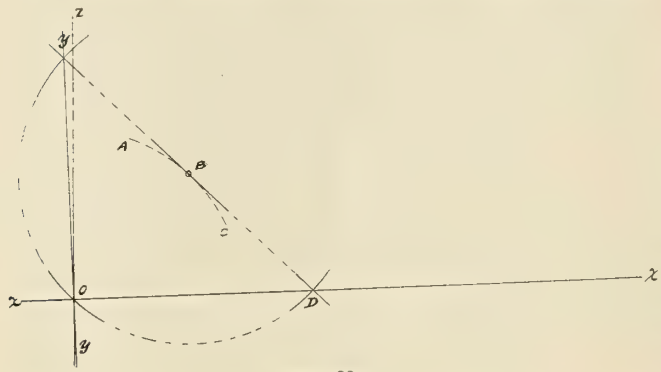


FIG. 82.

movement of the pencil relative to the piston. The simplest way to make this test is to move the piston by means of a uniform fine pitch screw. Attach a 10 or 20-pound spring to the indicator piston in the usual way, the instrument being secured in a fitting clamped in a bench vise, as above described. On the bottom of the piston, piston rod or piston rod nut of almost every indicator a lathe center will be found. File one end of a small brass rod to a point. Seat the point in the latter center, the rod projecting downward through the cock towards the sliding bar of the front jaw of the vise. If the reader has an inside micrometer at hand, the brass rod should be of the same diameter as the extension bar shown at the right in Fig. 83. The rod should be cut to a convenient length and clamped in the chuck above the micrometer head and the lower end of the micrometer seated in a center punch mark on the sliding bar of the vise or on a metal plate secured to the vise. Care should be taken to have the ends of the micrometer so placed that there will be no lateral movement, and the extension bar should be watched while under compression, in order that the

FIG. 83.

test may be stopped in case the rod should spring or bend. If an inside micrometer is not at hand one of the ordinary outside variety can be adapted to the job by casting a white metal block and fitting it to span the "anvil," as shown at *A* in Fig. 84. The brass extension rod *B* is screwed into the block. The frame of the micrometer must, of course, be rigidly secured to the metal piece holding the indicator, so that the whole rig is in line. If a micrometer is not to be had, one can be improvised with threaded rods and nuts, care being taken to provide a proper index so that the screw can be turned exactly one revolution at a time.

The gear being in readiness, put a card on the drum, turn the micrometer upward until it has a firm bearing on the piston; note the position of the index on the screw; apply the indicator pencil to the card; rotate the drum by pulling the cord, and draw a long, fine, horizontal line. Remove the pencil; let the drum recoil; turn the screw upward exactly one revolution and proceed as before. Repeat the operation until the pencil has risen a little over two inches above the original line. If the pencil is raised higher there is danger of injuring the piston spring. This test must be conducted with great care. The movement of the pencil is usually more than four times that of the piston, and a very small error in the screw movement will show an apparently large pencil error.

The calibration being completed, remove the diagram and test, as shown in Fig. 85. The diagram shows thirteen spaces.

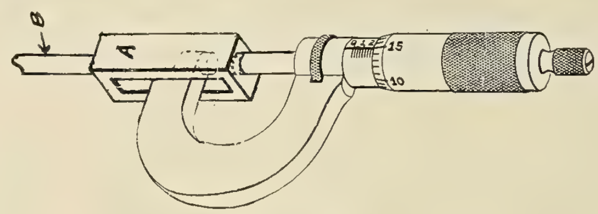


FIG. 84.

Count off the same number on any equally divided scale, the spaces being of such length that their sum will be a little greater than the distance between the top and bottom lines. Place the scale across the lines so that the extreme divisions—in this case *o* and 65—will fall on the top and bottom lines. If the test lines are equally spaced they will coincide with the main

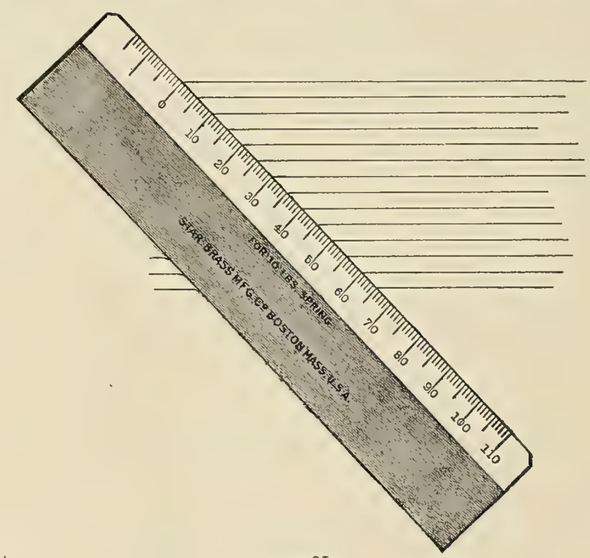


FIG. 85.

divisions of the scale,[2] as at *o*, 5, 10, 15..........65. This method of testing equally spaced lines should be remembered, as it is frequently made use of in indicator work.

(*To be continued.*)

Increased Economy in Coal and Oil Consumption by United States Naval Vessels.

In a statement prepared by the United States Navy Department, it is shown that a total of 350,296 tons of coal were used by the vessels in the navy during the first half of the fiscal year 1910. From the reports received by the Navy Department and the data compiled therefrom it appears that at a given speed per nautical mile run on the basis of an average for all the ships in commission, a decrease of about 12 percent in coal and 8 percent in oil is recorded. While this saving

[2] For by geometry we know that: "If a series of parallels, cutting two straight lines, intercept equal distances on one of these lines, they also intercept equal distances on the other." In this case one line being the edge of the diagonal rule and the other line a vertical line square with the parallels.

is partly due to less cruising service it should be noted that the saving of coal on that account was counterbalanced largely by the increased average speed at which the ships in general were cruising. The total amount of coal saved during the first half of the year amounted to about 56,000 tons.

The reasons for this increased economy are to be found not only in the improved design and type of machinery now used in American warships, as compared with older types, but also to the materially increased efficiency of the personnel in the operation of the machinery and in firing.

Some of the records which are particularly noticeable are the following: The battleship *Missouri* used 25 percent less coal per nautical mile run when under way during this period and 35 percent less while in port. With the *Kansas*, the saving was 12 percent, and with the *Rhode Island* 11 percent. The record for the *Missouri* is all the more remarkable when it is considered that this battleship has been in commission for seven years, and during that period has never been completely overhauled at a navy yard. Furthermore, on recent speed trials this vessel showed approximately a knot greater speed than on her official trials, when she was new and when a large bonus was to be paid for every additional half knot above contract speed. This increased speed was obtained on a greater displacement than that on which the builders' trials were carried out.

Still better results from an economical standpoint are anticipated in the coal consumption of ships where superheated steam is being used, and in oil where the steam turbine is used in place of the reciprocating engine.

LAUNCH OF THE BRITISH BATTLESHIP COLOSSUS.

The *Colossus*, the ninth British battleship of the Dreadnought type, was launched in April from the yards of Scott's Shipbuilding & Engineering Company, Greenock. This is the first battleship of the Dreadnought type launched on the Clyde, although the battle cruisers *Indomitable* and *Inflexible* were built there, the former at Fairfield and the latter at Clydebank. The Fairfield Company were also the contractors for the propelling machinery of the *Bellerophon*, and the Scott's Company supplied the propelling machinery for the *St. Vincent*, but the last battleship built in a Clyde yard for the Royal navy was the *Agamemnon*, built by William Beardmore & Company.

The *Agamemon's* immediate predecessors on the Clyde were the *Hindustan*, built at Clydebank, and the *Commonwealth*, built at Fairfield, both launched in 1903. Seven years have elapsed since then, but the development of the battleship has been notable in the short time. That progress can be followed by a table:

	Displacement.	I. H. P.	Designed Speed Knots.
Hindustan	16,350	18,000	18.5
Commonwealth.	16,300	18,000	18.5
Agamemnon ...	16,500	16,750	18
Colossus	20,250	25,000	21

The *Colossus* is 510 feet long and 86 feet beam. Her displacement is 20,250 tons, and her turbine engines, designed for 25,000 indicated horsepower, are expected to give her a speed of 21 knots.

The advance that has been made in respect of gun power may be shown by the statement that whereas the *Hindustan* and the *Commonwealth* have each only four 12-inch and four 9.2-inch guns, the *Colossus* will have ten 12-inch guns. The *Agamemnon* has fourteen guns of large caliber, but only four are 12-inch guns, the remainder being 9.2-inch guns of 50 calibers. All the nine Dreadnoughts are ten-gun ships. In the *Dreadnought*, the *Bellerophon*, the *Temeraire* and the *Superb* the length of the gun is 45 calibers, and in the *Vanguard*, the *Collingwood*, the *St. Vincent*, the *Neptune* and the *Colossus* it is 50 calibers.

The growth in size of the type of vessel is shown below:

	Length. Feet.	Beam. Feet.	Draft. Feet.	Displacem't. Tons.
Dreadnought	490	82	25½	17,900
Superb	490	82	27	18,600
Temeraire	490	82	27	18,600
Bellerophon	490	82	27	18,600
Vanguard	500	84	27	19,250
Collingwood	500	84	27	19,250
St. Vincent........	500	84	27	19,250
Neptune	510	86	..	20,250
Colossus	510	86	..	20,250

In the *Colossus* the 'midship guns are placed *en echelon*. The whole ten are available for use on either broadside. On the battleships the diagonally-placed guns fire across the deck, under a kind of boat deck. This structure accommodates the 4.7-inch guns of the anti-torpedo armament, which are not easy to place. The 4.7-inch gun is preserved for anti-torpedo armaments because of great rapidity of fire.

The *Colossus* is the first large variation of the *Dreadnought*. In broadside-fire design she presents a great improvement, in the diagonal placing of the two 'midship guns and the placing of the ten guns in five turrets on the middle line, as in the *Conqueror*, the *Monarch* and the *Thunderer*. In the latest twelve-gun German ships the arrangement is similar to that on the Brazilian *Minas Geraes* and *Sao Paulo*, except that the wing turrets are *en echelon*. The new French ships have adopted the *Minas Geraes* arrangement, and the American ships have their gun turrets on the middle line. The Americans were the pioneers of that disposition. The Japanese adhere to mixed armaments, on the experiences gained at Tsushima.

H. M. S. *Hercules*, sister ship to the *Colossus*, the contract for which was placed with Palmer's Shipbuilding & Iron Company, Jarrow-on-Tyne, is to be launched on May 10, and the *Warrego* (the third of the Australian torpedo boat destroyers) is to be completed in July. The *Warrego* is being built by the Fairfield Shipbuilding & Engineering Company, Clyde, and will be shipped in sections to Australia, and rebuilt in one of the Commonwealth dockyards by Australian workmen. The *Colossus* is to be ready for trials in nine months. Only nine months elapsed between the laying of the keel and the launch.

In this connection we may add that the two cruiser battleships, of the *Indefatigable* type, which are to be built for the governments of Australia and New Zealand, respectively, have been placed by the Admiralty. One is to be built by the Fairfield Shipbuilding & Engineering Company, Ltd., Clyde, and the other by Messrs. John Brown & Company, Ltd., Clydebank. They will each cost about £1,800,000, and they have been placed by the Admiralty by arrangement with the governments of Australia and New Zealand. They form parts of the fleet units which are to be provided by the two colonial governments, but they will be integral parts of the British navy, subject to the orders and regulations applying to the other ships of the fleet. They are additional to the five armored ships of this year's British naval programme, and will be completed in 1912.

Including the orders for the two colonial cruiser-battleships, there are now on hand on the Clyde twenty-nine British warships—two Dreadnought battleships, two Dreadnought cruisers, five protected cruisers and twenty torpedo boat destroyers.

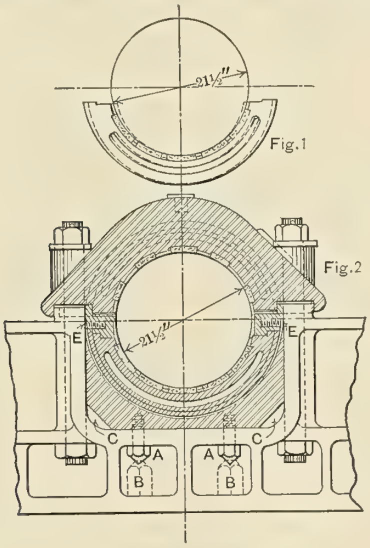
This is the largest number of vessels, and the largest tonnage, that have ever been under construction on the river at one time for the British navy. In addition, the district expects a share of the naval programme of the current year.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.*

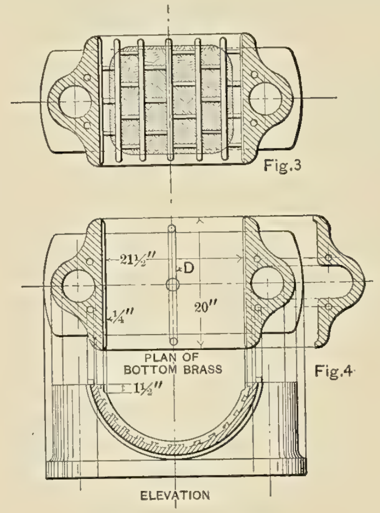
Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Brasses of Marine Engines.

During a two years' cruise in one of our large armored cruisers, having charge of both main engines, I had some experience with brass and bronze as used in heavy journals which may or may not be new to the many readers of your valuable paper. The main bearings, crank pin and wrist pin brasses gave the most trouble, but occasionally, and apparently without cause or provocation, the saddle-pin brasses, particularly those of the intermediate-pressure and low-pressure engines, would assert themselves. The main bearings were fitted substantially, as shown in Figs. 1 and 2. The caps and removable seatings for the bottom bearings were steel castings, but the bottom bearing or shell was of brass, and fitted as shown in partial section in Figs. 1 and 2. Both the caps and bottom bearings were water-jacketed and lined with white metal, or navy metal, as shown, the parting, or check pieces, being locked in position by two 1⅛-inch steel tap bolts, as shown at *E, E,* Fig. 2.



MAIN BEARINGS.



OIL-WAYS IN BRASSES.

If heating of the bearing should occur it would seem very improbable that the bottom brass, from its being locked in position by the tap bolts, and again secured by the caps through the lip on the cheek or parting pieces, could spring enough to put a permanent set in it. Yet such is the fact. And upon turning out two of these bottom brasses that had become heated before I joined the ship to ascertain their condition, it was found later on, by calipering the brass before refitting, that they had closed in ¼ inch, as shown by the dotted lines in Fig. 1. In first looking over the brass it was thought that refitting was all that would be necessary. The loose babbit was therefore scraped out and the oil-ways trimmed about their edges, and when all the clips were carefully wiped out the mandrel for refitting the main bearing brasses was carefully covered with a thin coating of Prussian blue and dropped into the shell as it lay upon the floor plates.

Here is where our trouble commenced, for a 5-horsepower engine, plus a team of bulls, would have been needed to turn the mandrel in its seating, when it should have spun around easily by hand. The mandrel was lifted, and the cause of its sticking was apparent. The brass bore beautifully upon a strip of the white metal, about an inch wide, and clear across both open edges of the brass, but it never hit a single spot below this or in the crown. Then we calipered the outside of the shell carefully, and also a spare brass that was in the shaft alley, and we found that there was a difference of a scant ¼ inch between the two. My first idea was to set up the brass and bore it out to size and then turn it back into place. But as we had only five hours in which to keep the engine adrift I concluded to put in the spare, and have the old brass sprung back to size and rebabbited at the navy yard, where we were due in about a week.

The spare was therefore fitted and turned in with the jacking engine, and the old brass secured upon the bulkhead in the shaft alley, and straightened and rebabbited at the navy yard. While at the navy yard the ship's force began overhauling and readjusting the crank pin, wrist pin, saddle pin and main bearing brasses. The starboard intermediate-pressure crank pin had run more or less hot ever since I had joined the ship, and as I was assured that this set of brasses had been refitted but lately, I began a hunt for the cause of their heating.

I had both half brasses removed, and gave them a good inspection, but they seemed, without recourse to any measurements, to be all right. There were traces of the brasses having been hot enough to have started the babbit slightly in several small spots along the edges of the oil-ways. These were carefully scraped out, and after thoroughly wiping out both half brasses and cleaning the pin they were reassembled on the pin. I now removed a No. 33 B. W. G. liner, and drove the brasses up hard, until the full power of the jacking engine would just move the main engine. With the brasses set up like this the main engine was jacked around two full turns and the brasses opened out again. The cause of the heating was then plainly in evidence, for the only bearing they had was the unshaded portion, as shown in Fig. 3.

The man who had fitted these brasses, when last overhauled, assured me that they had a perfect bearing, as shown in the

* We pay for these articles.

shaded portion of Fig. 3, and I believed him. The trouble was that some one of the oilers had let the pin get away from him, and not called the attention of the officer of the watch to it. However, the mandrel was called into use and the brasses given a thorough refit, and left as shown in the shaded portion in Fig. 3. To do this, however, it was necessary to remove .018-inch liners when the final leads were taken and the brasses set up to 31 B. W. G. Heating would spring these brasses in this manner every time.

On our first run, during a period of three days, and at a speed of 100 revolutions per minute, these brasses ran perfectly cool, and afterward, when we ran for two hours at 120 revolutions per minute, followed by a forced draft trial of four hours, at which they averaged 136.3 revolutions per minute, they remained cool. I have now described the effect, and will try and point out the cause of the springing, or changing shape of these and similar brasses. For a cause, and a very plausible one, we have not far to look.

In a table of coefficients of expansion of metals I find that the coefficient of bronze (cast) is .0000099, while that for steel (cast) is but .0000064; therefore, there is a difference between the two metals of about 1.39 times. And as the bronze expands 1.39 times as much as the steel that comprises the rest of the bearing, and must therefore go somewhere, following, of course, the line of least resistance, it naturally would close in upon the shaft or pin, causing still further heating by gripping or seizing the bearing surface of the shaft or pin.

I have seen many large engines, marine type, fitted to drive power generators, and all of those I saw built by the Union Iron Works were fitted with steel shells, white metal lined, for main bearing and crank pin, as well as wrist-pin brasses, and all of them ran all right.

When I first began erecting work for high-speed engine builders the engines were principally used for electric lighting, and the first of these were fitted with brass crank-pin boxes. Whether lined or unlined, they all gave trouble; then came the change to cast iron, white metal lined, steel castings not being as common twenty-five years ago as they are now. And at the present time to build modern engines for high duty, high speed and heavy work, with weights being cut down to the minimum, and return to brass or bronze in heavy bearings, would seem like retrograde progression. I can see no object in the use of brass or bronze for this purpose whatever.

The saddle-pin brasses of the engines in the cruiser referred to were simple, straight shells, without flanges, about 5/8 inch thick, 5 inches long, and worked upon a 5-inch pin. These would always close in after becoming heated, but could be drawn back to shape by peening; but this treatment is only a makeshift job when it comes to main bearing shells for a 21½-inch shaft, especially when cored out for water service.

While serving upon one of our modern battleships some years ago, during our trial runs over the measured mile, in order to standardize the screws, the No. 1 main bearing of the starboard engine developed a heavy one-ended thump when at full speed (136 revolutions per minute). As the engines were still in the hands of the builders we could only offer suggestions, as it was up to them to locate and remedy the trouble. But in this they failed, and the engines, thump and all, were finally turned over to Uncle Sam a couple of months later. I at once began a hunt for the trouble, and was sure, from the very start, that this bearing was low. Reference again to Fig. 2 will explain how I arrived at the amount that this bearing was low, and how I remedied the trouble without turning out the brass.

I had four tap bolts made with conical heads, as shown at *A, A*, and replaced the original tap bolts with these. I then fitted four steel blocks, with a light countersink in each, and set them under the tap bolts on the web of the engine seating. We then lifted the main bearing cap clear of the shaft, and with one man at each of the tap bolts began to back them out. These, being tapped into the seating for the main bearing shell, began to lift the seating and brass up to the shaft. With wrenches 10 inches long, upon the 1⅛-inch tap bolts, we raised the seating and brass a full 1/16 inch, until it was up to the shaft, solid. I then inserted four steel wedges, one in each of the slots *C, C*, in order to hold the brass up in place, and then removed the tap bolts altogether. A liner was now fitted, of proper thickness, with holes for the four tap bolts. This was pushed into place and the original tap bolts screwed back into their places. My new bolts and the steel blocks were turned into the storeroom for future use upon similar jobs.

It is needless to say that our job was a good, solid one, and that the one-ended thump entirely disappeared. I would recommend this rig when bearings are fitted similarly. When we arrived at the navy yard I turned in two sets of crank-pin brasses, one high-pressure and one intermediate-pressure, to be rebabbited. I suggested that no oil-ways be cut in them, for I would cut them as I wanted them with the ship's force.

Excepting these particular sets of crank-pin brasses all of the others had oil-ways 5/8 inch wide and 3/8 inch deep, and of the form shown in Fig. 3.

When the brasses had been returned on board, after they were carefully fitted and given a bearing, as shown by the shaded portion in Fig. 3, I had a chamfer cut across their open edges ¼ inch by 1½ inches, as shown in Fig. 4, but no other oil-ways were cut in the bottom halves. In the top halves, in addition to the oil-ways as cut in the lower halves, I ran a channel clear across the crown of the brass, thus joining the three oil holes, as shown by the dotted lines, these channels being ¾ inch wide and ¼ inch deep. I thus gained about 115 square inches in the projected area of the bearing surface over the former oil-ways. The idea of departing from fixed rules and practices made the ancient and honorable mechanics of the navy yard, who watched these bearings being fitted and the oil-ways cut, shake their venerable heads with awe and amazement. All sorts of trouble was predicted for us, and some were willing to believe that the number of minutes these brasses would run could be counted upon the fingers of one hand.

However, as these men were to take no active part in any crank-pin drill that we might bring upon ourselves while at sea their sarcasms were wasted, for they fell upon deaf ears. These brasses were all well fitted, and given a perfect bearing both top and bottom, then put up, and the engines jacked around, with the brasses and pin dry, in order to see if they were parallel; then they were taken down and examined, and when finally set up and adjusted the leads showed No. 31, B. W. G.

After leaving the yard these brasses ran cool and gave no trouble whatever, and they made, in round numbers, before taking down again some 13,000 nautical miles. When they were finally opened up for inspection a set of leads showed .018 inch clearance, and the working surfaces were like mirrors. With this clearance they did not have a sign of a pound, although when feeling them at sea the mixture of oil and lather would have a perceptible squash, and was thrown from the pins as white as snow. About .010 inch was the limit of slack on any of the other pins before they became noisy. This I attributed to the lather being forced into the large oil channels, and therefore being unable to cushion the pins.

E. A. BLACKWELL, U. S. N.

Kingston, N. Y.

The average speed of the United States battleship *South Carolina* on her official twenty-four-hour trial trip was 18.85 knots. This is a creditable increase over the 17.68 knots attained on her preliminary acceptance trial.

Stop Valve Troubles.

The stop valves of marine engines are operated either by a handle or by a hand-wheel. In the first case a slide valve is moved by the handle, and in the second the turning of the hand-wheel gives way to the steam. It is difficult to say which method is better, but each has certain advantages under certain conditions. By means of a slide valve the revolutions are altered much more quickly than by a lift valve and hand-wheel, and such a valve must, therefore, be accompanied by a throttle valve, which may be used in heavy weather to diminish the racing of the engine as much as possible. It is, however, difficult to make a throttle valve perfectly steam tight, and most engineers know that with the throttle valve closed, many engines cannot be slowed down further than to half speed, due to the leaking of the steam. There is less

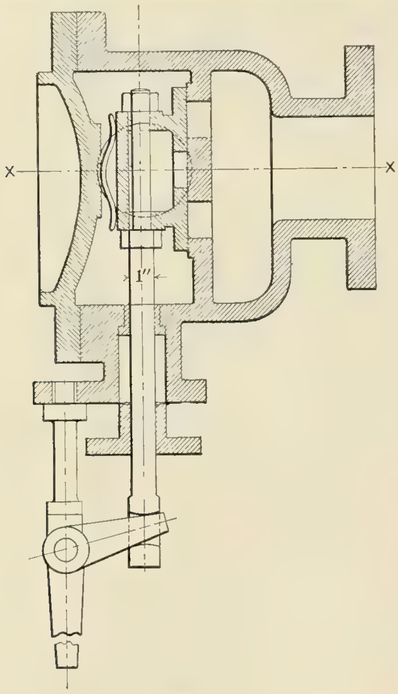


FIG. 1.

leakage with the lift valve than with the slide valve, and this is remarkable, since the slide valve has such a large area that some means have to be provided for cutting off a portion of it from the action of the steam pressure. From the foregoing it is evident that a slide valve is better for high-speed engines, as there the effect of racing is more disastrous.

The diameter of the engine stop valve need not be the same as that of the main steam pipe. This is seen when closing from a wide-open position, a lift valve, the lift of which is one-quarter of the valve diameter. If six turns of the hand-wheel are necessary to completely shut the valve, no alteration in the revolutions of the engine will be seen until the fourth turn of the hand-wheel has been made, while the last two turns will stop the engine entirely. For this reason the stop valves of the engines in the German navy have a diameter of two-thirds the diameter of the steam pipe. The cost of the valves is thus lower and the weight less.

On the trial trip of the tug *E* while maneuvering, the lift valve was fully opened, and then the telegraph indicating stop, the hand-wheel was turned, but this took so much time that the handle of the reversing gear as put square too late and the boat touched the shore. The engine immediately began racing severely, indicating that some blades were off the propellers. On examination it was seen that all four blades had been broken. In this case a slide valve would have prevented the mishap.

Faults in the construction of slide valves are possible, as the following will show. On a compound engine of 250 indicated horsepower a slide valve (Fig. 1) had been fitted, and when steam was on the engineer was frequently troubled by the falling down of the valve, thus opening a passage for

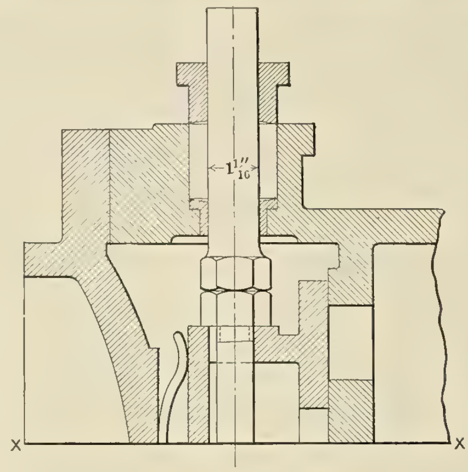


FIG. 2.

steam when it was not desired. It was thought at first that the valve was blown down, due to the great velocity of the steam. The engineer, therefore, screwed up the packing gland so that the resistance of the packing was greater than the force of the steam, but this made closing of the valve somewhat difficult.

On another engine the stop-valve operating mechanism was made as indicated in Fig. 3. The crank *A* turned a rod on which an eccentric *B* was fixed. The eccentric rod moved the valve, which was set horizontally. The action of the steam

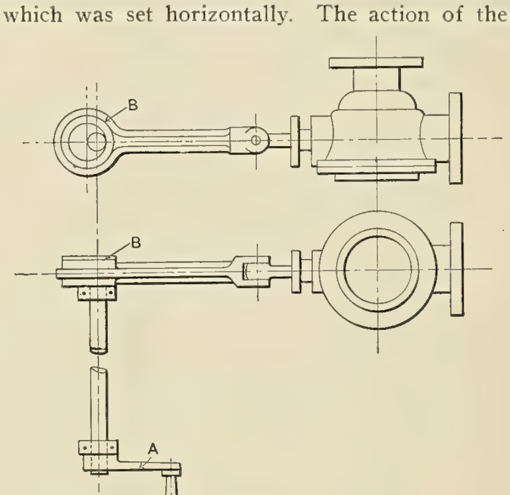


FIG. 3.

could not move the eccentric, but less pull was required for opening the valve than for closing it. After some time the reason for this was better understood, and the arrangement was altered. The steam pressure was 192 pounds per square inch, the diameter of the valve rod 1 inch, and as this rod was led through a stuffing box on one side only, the force acting downwards on the valve would be

$$\frac{3.1416}{4} \times (1)^2 \times 192 = 150 \text{ pounds.}$$

This force acting in a downward direction on the valve was resisted by the frictional resistance of the valve plus the frictional resistance of the rod in the stuffing box. Since these two resistances amounted to less than 150 pounds, the valve was moved downward.

The valve was changed as shown in Fig. 2. A check nut in

the form of a rod which extended through the top of the valve case was provided and a stuffing box was fitted. The diameter of this rod was made 1 1/16 inches, thus a resultant force acting upwards on the valve was obtained of

$$\frac{3.1416}{4} \times [(1\ 1/16)^2 - (1)^2] \times 192 \text{ pounds.}$$

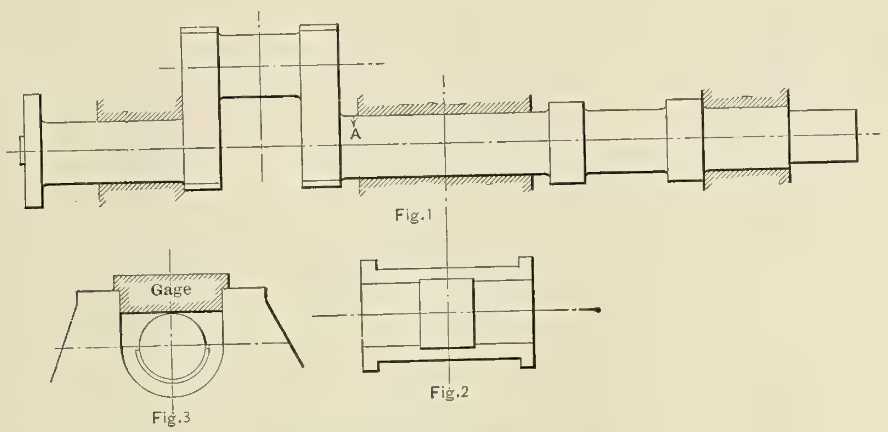
This force was about equal to the weight of the valve and rod, so that the valve was then perfectly balanced. After this was done the force of the steam was no longer felt on the valve. D. K.

A Broken Crank Shaft.

The bearings of shafts and brasses of pins and journals are nearly always designed for adjustment for wear. A liner and some thin plates are inserted between the brasses, so that when these are somewhat worn a thin plate may be taken out. After all the thin plates have been taken out, the liner must be filed off until the brasses are to be renewed or relined. In the latter case a new liner must be made. There is no objection to taking away some of the thin plates from the brasses of a pin, but in the case of a shaft resting in three or more bearings, care should be taken that more plates are not taken out of one bearing than from the other, as in that case the shaft may be subjected to severe bending moments.

The crankshaft of the compound engine of the tug *T* rested in three bearings, Fig. 1, the center bearing being very long. Due to the length of the center bearing the outer bearings wore more than the middle one. The engineer took off the thin plates from the outer bearings without scraping out the middle one. Therefore, when the caps were screwed down, the shaft necessarily bent. The last time this was done the boat was towing a small ship on a river, the engine working about half power. After a few hours a second ship was picked up and the stop valve open wide. After proceeding in this manner for about half an hour, the crankshaft broke at *A* close to the edge of the center bearing. It is evident that the shaft had been bent about this point when the caps of the outer bearings were screwed down. Another tug took over the tow and the boat herself was towed to the engine works, where a new crankshaft was ordered. The broken shaft was made to Lloyd's requirements, but the needlessly severe bending moments caused the fracture. When the new shaft was fitted, the center bearing was recessed, as indicated in Fig. 2, so that the wear might be equalized.

It is essential that the wear in the bearings may be regularly controlled by the aid of gages for each bearing, since with large engines it is a very troublesome job to lift the shaft. On one steamer, where there were continual changes in the engine-room staff, it was thought that the crankshaft had worn its bearings unduly and dropped too much, so that the renewal of the end brasses would be necessary. The engineers hunted for a gage but could not find it. Finally one of the firemen remembered having seen such a plate and found it under the floor plates. By using it it was found that the shaft had not dropped more than 1/16 inch, so that the renewal of the brasses was unnecessary; thus considerable time and money were saved. D. K.



DETAILS OF SHAFT BEARINGS ON TUG T.

A Fractured Rudder Head.

In January, 1899, while the steamship *Morehead* was steaming against a severe northwest gale in mid-Atlantic, a peculiar accident in the nature of a break occurred to the rudder post. Fortunately, the position of the break was just above the deck bearing, and it extended diagonally to the quadrant head.

Naturally, the deck officers assumed the responsibility to effect repairs. Securing considerable timber of all dimensions from the cargo they proceeded to build a jury rudder, about 12 feet by 16 feet, with the intention of rigging it to the stern. However, the folly of this was soon apparent, as rigging timber to the stern in a heavy gale was entirely out of the question. As usual, they then sought suggestions among the engineers, and the credit for successful repairs must be given to the men "under the grating."

It was decided to use the spare bottom-end brasses to clamp around the fractured rudder post, as nothing else available would answer as well. In calipering the post it was found to be exactly 12 inches in diameter. The brasses were bored for the crankpins, which were 14 inches in diameter, consequently some means had to be devised to fill in between the brasses and the post. Many ideas were submitted, each receiving more criticisms than approvals, until the idea of stripping the 2-ton chain block and winding the chain around the post to fill the space was suggested.

When the brasses were finally brought aft to complete the job, it was found that they were entirely too wide to fit between the quadrant head. In measuring it was seen that by the removal of one cheek from each brass they would make a suitable fit. To cut the cheeks away it was necessary to drill about twenty ¾-inch holes around each cheek and split it away with a flogging chisel and "monday." After this was finished the brasses securely clamped to the chain-wound rudder post.

The engineer's repair job occupied about six hours to complete, making a thoroughly sound repair. It proved entirely, satisfactorily, as severe gales and heavy seas were met with for several days after without affecting it in any way. Port was finally reached, where an entirely new post was made.

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Mechanical Gearing for Turbines.

The possibilities of the commercial application of the marine steam turbine in the event of the development of a successful reduction gear so that the most efficent speed of both the turbine and propeller can be realized without undue loss have been widely discussed, and the value of such a device is beyond question. Of exceptional interest, therefore, are the results obtained by Mr. Parsons with his experimental gear on the *Vespasian*, an account of which is published on page 253. Although at the time Mr. Parsons' paper was prepared only a few tests had been carried out, yet enough had been done to show that under normal full-speed steaming conditions an increase of about one knot was realized with the turbine-geared engines over the reciprocating engines with the same coal consumption. It is claimed that the turbine and gearing has given no trouble and has run with little noise or vibration. Whether long and hard usage will impair the efficiency of the gear, of course time alone will tell, but it is under such conditions that the gear must operate if it is to be universally applied to slow-speed merchant vessels, and the matter of durability will be watched with interest.

Fire Boats.

We are publishing this month detailed descriptions of the latest additions to the fast-growing fleet of American fire boats. A glance at these designs emphasizes the fact that each problem in the design of this special type of boat must be studied by itself. Conditions vary so widely in different harbors that qualities which would at first thought seem essential in a boat designed for fire fighting must either be eliminated entirely or greatly modified. In the Chicago fire boats, for instance, which were described in our September, 1908, issue, speed, which at first thought would seem a prime necessity in a fire boat, was of little moment, since the narrow and obstructed river in which they were to operate imposed a practical limit to the speed at which the boats could be navigated. Similarly, by reason of the nature of the harbor, it was of exceptional advantage for the pilot to have direct and complete control over the movements of the vessel, and consequently the unique system of combined turbine and electric drive controlled directly from the pilot house was of special advantage in these boats. In the new Boston boat, described this month, we again find a special design to meet special conditions. In this case natural conditions were the deciding factor in the design of the hull. It was found necessary, on account of the shallow draft in many parts of the harbor and the presence of a large number of drawbridges and the prevalence of heavy ice in winter, to build a hull of exceptional local strength to withstand the continual rough usage due to contact with such obstructions. The hull was therefore built of wood instead of steel, and sheathed with copper in order to prevent fouling. Another unique feature of the Boston boat which will undoubtedly cause comment is the use of the smokestack as a water tower. Besides decreasing the cost of installation, this obviates the necessity of exposing a man in a dangerous position where he has little opportunity to escape a sudden blast of flame or falling débris.

Members of the American Society of Naval Architects who attended the annual meetings of the society in New York in 1908 will recall the pertinent criticisms of fire-boat designs made by the chief of the marine division of the New York fire department. According to Chief Kenlon, speed, large boiler capacity, pumps of large capacity capable of delivering the water at more than 150 pounds pressure, combined in a hull of not more than 10 feet draft or 120 feet length, would represent good fire-boat practice. To fulfil these conditions water-tube boilers and centrifugal pumps would seem to offer special advantages, while the use of steam turbines would give opportunity for a still further reduction in weight. Oil fuel might also be used to advantage on such a boat, as it offers a ready means of getting up steam quickly and of maintaining full boiler pressure while the boat is in operation.

Engineering Efficiency in the Navy.

Marine engineering in the navy naturally falls under two heads, designing and operating. Both branches are closely related, and they must receive equal attention in order that the highest efficiency may be maintained both from a military and from an engineering standpoint. Military efficiency, in fact, now depends very largely upon engineering efficiency, since practically every function performed by a modern warship is controlled by power. But the best efficiency can only be obtained when a well-designed ship is operated by expert engineers. The problem of engineering efficiency in the navy therefore resolves itself into the provision of a suitably trained corps of designers of broad experience and exceptional ability and the improvement of the work of the engineer officers and engine-room and fire-room forces aboard ship. According to advices from the Navy Department, good progress is being made in both these directions in the United States Navy.

In the first place, it is natural to expect that the latest vessels should show increased economy in fuel and oil consumption over those of earlier design, due to the improvements which are continually being made in naval boilers, engines and auxiliaries. Recent developments in the use of superheated steam, forced draft, improved methods of firing, better condenser practice, the adoption of centrifugal pumps and steam turbines for certain classes of work, the more extended use of electric power, and improvements in the design of electric machinery have all helped to bring about increased efficiency in the newer vessels. Economy from such sources, however, is more or less a matter of course, as it is the natural outcome of the progress of engineering science, but aside from such improvements some remarkable records of efficiency and economy have recently been made which are the direct outcome of the efficient administration of the Bureau of Steam Engineering and the commendable policy of the Navy Department in arousing the ambition of the engineer force by opening the way to promotion and advancement as a reward for ability and efficient work.

As a result of such methods, vessels which have been in service from five to ten years are now making higher speeds on greater displacements than they attained on their official acceptance trials, where there was every incentive and every precaution was taken on the part of the builders to make a record showing. Furthermore, these records have been made under cruising conditions, with ordinary coal and without placing the ship in dry dock to clean the hull. Increased speed under such conditions of added resistance means that the naval engineers are getting far more than the designed horsepower from the main engines. That this is being done without any concessions to economy is evident from the fact that since December the average coal consumption of all naval vessels per knot run at a given speed has decreased 5 percent and at the same time the average mileage per gallon of lubricating oil has increased 8 percent. In individual cases, as noted elsewhere in this issue, the saving in coal and oil has been even more marked. A remarkable decrease in the expenditures for packing is also reported. Results such as these can only be obtained by the most careful attention to details and the maintenance of a high standard of efficiency in the engineering personnel.

Efficiency in this case, as in a good many others, is largely due to competition. Until recently very little has been done in the way of direct encouragement for the engineer force on naval vessels, but now steaming economy competitions are held and cash prizes are awarded to the ship showing the best general efficiency and economy in coal consumption. Not only is there a direct reward in the shape of money to be gained as a result of general excellence, but there are also opportunities for advancement and promotion to positions in the manufacturing departments in navy yards. Furthermore, the future designers of naval machinery are to be appointed from the engineer force by a process of selection in which ability and practical results will be the principal consideration. Ten engineer officers who have had at least three years' sea service will be selected each year and given a two years' post-graduate course of study in the new school of marine engineering at Annapolis. It is expected that the combination of theoretical and practical training which these men will receive, coupled with the fact that they are already men of achievement, will result in developing the highest type of engineering ability and efficiency for this important branch of the service. A complete account of the organization and work of this school will be published in our next issue, so that our readers can judge for themselves of the value of this factor in the efficiency of naval engineering.

No discussion of engineering efficiency in the navy would be complete without some reference to the standard of naval specifications and the cost of repairs to naval machinery. As compared with merchant practice, United States naval specifications are so much more severe that the first cost of naval machinery is greatly in excess of that for merchant vessels. This fact has led to much criticism by engineers engaged in commercial work, and it has not entirely escaped the notice of observant taxpayers. The increased first cost of naval machinery, however, has proved a wise investment in most cases, for it has resulted in a lower cost of repairs per horsepower than can be shown by any merchant fleet in the world, and there are few, if any, large power plants on shore that can show as good or better results in this respect. In fact, the money saved in repairs represents a high rate of interest on the increased first cost of the machinery. Not only this, but the efficiency of the ship from a military point of view is greatly enhanced by the infrequent necessity for repairs and the ability of the engineer force to effect the slight repairs necessary on board ship without taking the vessel to a navy yard.

Progress of Naval Vessels.

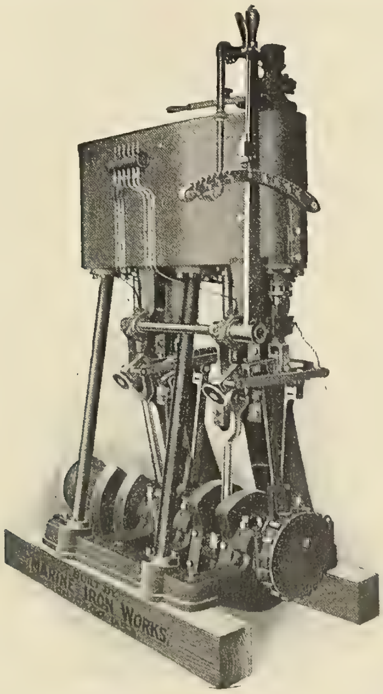
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		Apl. 1.	May 1.
BATTLESHIPS.					
North Dakota	20,000	21	Fore River Shipbuilding Co.	99.7	100.0
Florida	20,000	20¾	Navy Yard, New York	59.0	63.4
Utah	20,000	20¾	New York Shipbuilding Co.	68.5	72.0
Arkansas	26,000	20½	New York Shipbuilding Co.	19.5	24.0
Wyoming	26,000	20½	Wm. Cramp Sons	15.7	19.0
TORPEDO-BOAT DESTROYERS.					
Paulding	742	29½	Bath Iron Works	81.1	86.8
Drayton	742	29½	Bath Iron Works	73.6	77.6
Roe	742	29½	Newp't News Shipbuilding Co.	81.4	85.1
Terry	742	29½	Newp't News Shipbuilding Co.	79.9	82.4
Perkins	742	29½	Fore River Shipbuilding Co.	67.7	72.9
Sterrett	742	29½	Fore River Shipbuilding Co.	66.9	71.4
McCall	742	29½	New York Shipbuilding Co.	56.8	66.9
Burrows	742	29½	New York Shipbuilding Co.	56.2	65.6
Warrington	742	29½	Wm. Cramp & Sons	65.5	67.5
Mayrant	742	29½	Wm. Cramp & Sons	69.7	72.6
Monaghan	742	29½	Newp't News Shipbuilding Co.	17.7	18.3
Trippe	742	29½	Bath Iron Works	25.3	31.9
Walke	742	29½	Fore River Shipbuilding Co.	19.2	27.5
Ammen	742	29½	New York Shipbuilding Co.	19.4	30.9
Patterson	742	29½	Wm. Cramp & Sons	12.1	17.8
SUBMARINE TORPEDO BOATS.					
Salmon	...	..	Fore River Shipbuilding Co.	91.7	92.7
Seal	...	..	Newp't News Shipbuilding Co.	47.1	48.9
Carp	...	..	Union Iron Works	45.7	47.6
Barracuda	...	..	Union Iron Works	46.1	47.6
Pickerel	...	..	The Moran Co.	43.3	46.4
Skate	...	..	The Moran Co.	43.3	46.1
Skipjack	...	..	Fore River Shipbuilding Co.	35.3	37.6
Sturgeon	...	..	Fore River Shipbuilding Co.	34.7	36.7
Tuna	...	..	Newp't News Shipbuilding Co.	21.2	22.2
Thrasher	...	..	Wm. Cramp & Sons	4.3	4.7

ENGINEERING SPECIALTIES.

An Engine with a Record.

Our attention has recently been called to the remarkable performance of a medium-sized compound marine engine, built about four years ago by the Marine Iron Works, Clybourn and Southport avenues, Chicago, Ill. During the four years in which this engine has been in service, it has been con-

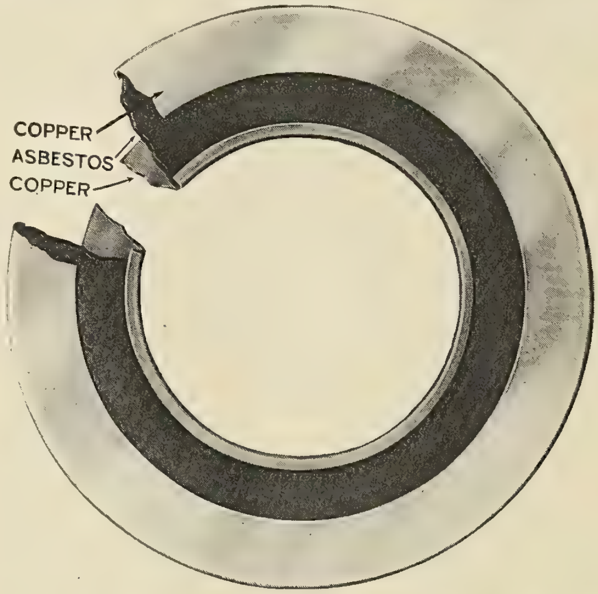


stantly engaged in hard, steady work in a fishing tug, the owner of which states that during this entire period the expense for repairs has been less than 25 cents (one shilling). This is a record which is certainly remarkable and testifies to the excellence in the design and construction of the engine.

The engine is of the fore-and-aft compound type, having cylinders 8 inches and 17 inches diameter, with a stroke of 12 inches. The high-pressure cylinder is fitted with a balanced piston valve having expansion rings. The low-pressure cylinder is fitted with a double-ported slide valve. The engine is of the heavy service, "bar" guide design, having hollow cast iron back columns and front columns of turned and polished forgings. The crankshaft is a solid forging, finished to 4 inches diameter, with crank-pins of the same diameter. The principal wearing parts are fitted up with adjustable take-up attachments. Appliances are fitted for lubricating each moving part. Steel and bronze are used to a considerable degree, to give strength and yet minimize the weight. The builders state there is no fancy work about the engine, but that it is intended to be a good, plain, substantial machine, which will bring about economy through low cost of repairs. The same company also builds single and double high-pressure, heavy service, triple-expansion stern and side paddle wheel engines ranging from 25 to 700 horsepower.

The National Safety Gasket.

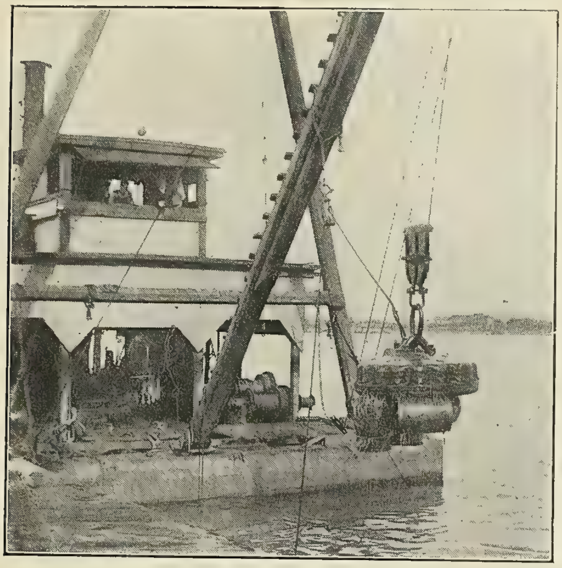
The Dyna-Como Company, Inc., 161 Devonshire street, Boston, Mass., is placing on the market the National safety gasket. This gasket is made of copper and asbestos equally distributed, forming a metal and fiber bearing on each flange. Since the asbestos is held by the copper, it is impossible for it to spread after once being made tight. It is claimed that the



gasket can be quickly and easily inserted; that it will withstand vibration, contraction and expansion; that it will make a perfectly tight joint on pipe lines, where the steam is frequently turned on and off; that it will not spread nor blow out; that it is safe and does not have to be followed up; and, finally, that it can be taken out of the flange and used over many times. This latter claim is, of course, of great importance from an economical standpoint. The gasket is designed to hold steam, water, gas or air pressure.

Lifting Magnets for Salvage Work.

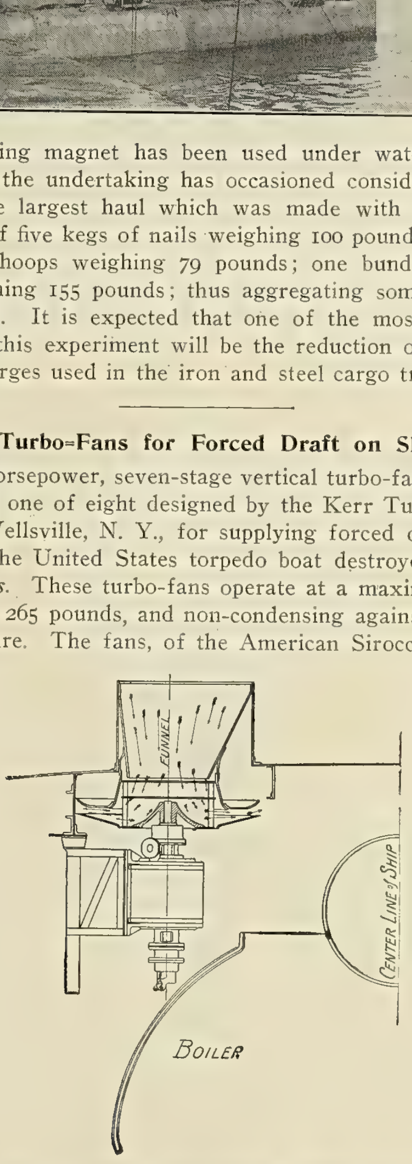
Recently a barge which had been towed from Pittsburg to New Orleans, laden with 1,500 tons of wire nails in kegs, steel barrel hoops, staples and barb wire, broke loose from the tug which was landing her, struck the wharf and sank in water about 100 feet deep where the current was excessive. The salvage of this cargo was accomplished by means of electric-lifting magnets supplied by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This is the first time that an



electric-lifting magnet has been used under water, and the success of the undertaking has occasioned considerable comment. The largest haul which was made with the magnet consisted of five kegs of nails weighing 100 pounds each: one bundle of hoops weighing 79 pounds; one bundle of fence wire, weighing 155 pounds; thus aggregating somewhat over 700 pounds. It is expected that one of the most important results of this experiment will be the reduction of insurance rates on barges used in the iron and steel cargo trade.

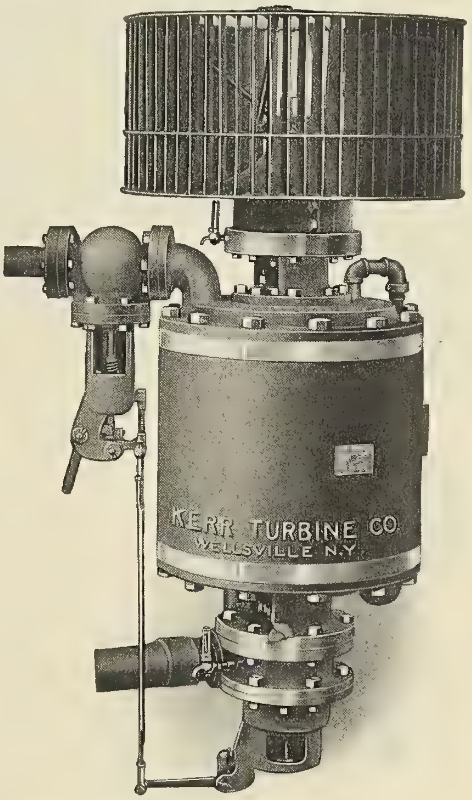
Vertical Turbo=Fans for Forced Draft on Shipboard.

The 50-horsepower, seven-stage vertical turbo-fan which we illustrate is one of eight designed by the Kerr Turbine Company, of Wellsville, N. Y., for supplying forced draft to the boilers of the United States torpedo boat destroyers *Sterrett* and *Perkins*. These turbo-fans operate at a maximum steam pressure of 265 pounds, and non-condensing against 5 pounds back pressure. The fans, of the American Sirocco type, are



placed to take air from the outside through funnels on the deck and discharge it into the fire-room through adjustable cone-shaped casings. Two fans, each operating at 1,655 revolutions per minute, deliver 40,000 cubic feet of free air per minute into each engine room, maintaining within a pressure equivalent to 4 inches of water.

The installation arrangement is shown in the line diagram. The turbines are made right and left, and are arranged in pairs, one pair delivering into each fire-room. One unit is bolted directly onto a vertical stanchion on each side of the boiler. It is evident from the diagram that the space restrictions are quite severe. Small diameter of the turbine is an important requirement, and this was made possible without reducing the power below the desired limit, only by using seven rotors, each 12 inches in diameter. The use of many stages with light rotors of small diameter in these turbines also overcomes trouble from gyroscopic action better than using few rotors of larger diameter. Experience has shown that in marine work the gyroscopic action of large, heavy



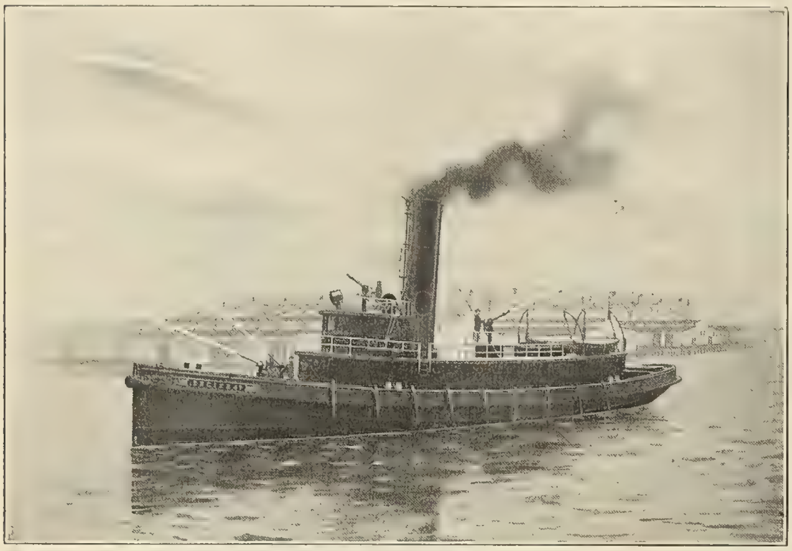
turbine wheels running in a horizontal plane and with bearings close together subjects the bearings to heavy side pressure as the boat rolls.

It is claimed that Kerr turbines are meeting with considerable favor for driving electric generators on shipboard and for driving marine auxiliaries, because of their economy, compactness, reliability and the absence of oil from their exhaust. A turbine is always clean in appearance and seldom requires attention. The test economy is maintained indefinitely, as there are no internal parts to rub and wear. This is of special advantage in driving fans and pumps where the grinding of dirt and cinders on the rubbing surfaces of a reciprocating unit would render more attention necessary.

Invincible Nozzles for Fire Boats.

The efficiency of a fireboat depends largely upon the efficiency of the nozzles, since they must have a low friction loss and deliver solid streams of water. Friction loss is materially reduced by large waterways, by the absence of sudden changes in section and by avoiding impact. Solidity of the stream, on the other hand, is largely a matter of experiment, and the higher the pressure the more difficult it is of attainment. Furthermore, all joints in the nozzle must be watertight, and yet the stream must be easily directed. To meet these requirements the Invincible nozzle has been designed by Andrew J. Morse & Son, Inc., Boston, Mass. This nozzle carries a partition well down into the throat of the Y, and separates the water into two parallel streams with, it is claimed, practically no loss or eddies. The water thus travels

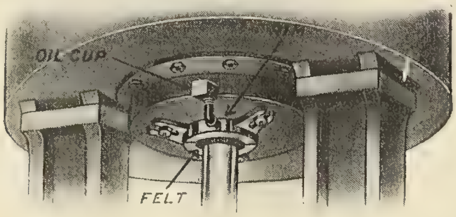
through two arms of uniform size and without obstructions. The two streams thus run parallel before uniting in one, thus avoiding friction losses. After thus uniting, the stream passes through a smooth play pipe, and the water is discharged



through a properly shaped tip, giving a solid stream, as shown in the illustration. The illustration shows the new Boston fireboat *Engine* 47, a description of which will be found elsewhere in this issue.

The Peerless Oiler and Wiper.

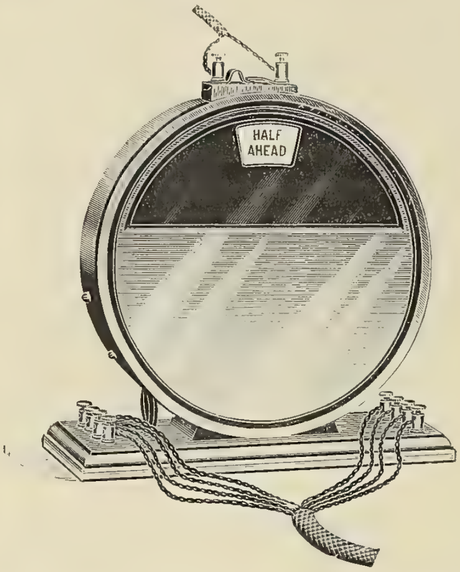
The Peerless oiler and wiper manufactured by the Peerless Oiler & Wiper Company, 100 William street, New York, has been designed to obtain proper lubrication between the piston rod and the packing. Steam is known to dissolve any oil, grease or compound used in packings, so that with ordinary packing the engineer can never be sure how long it is going to last. Furthermore, when fiber rod packing wears, leaks are taken up by tightening up the gland studs, so that the packing wears further, losing its elasticity, increasing the friction on the piston rod, interfering with the proper lubri-



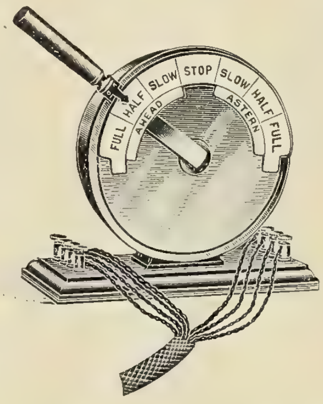
cation of the rod and even scoring it. The Peerless oiler and wiper is attached to the gland studs in such a manner that the felt encircles the rod and a brass oil cup is connected to the device. The cup has an eighth-inch hole, and the hole is covered with felt. The oil permeates the felt and passes through the small pipe to the felt that encircles the rod. It is claimed that the action of the oil on the felt is the same as a lamp wick, giving positive action with every stroke of the rod. It is claimed, also that this continuous lubrication of the rod with every stroke reduces friction to a minimum and prevents the scoring and wearing of the rod. Furthermore, it is claimed that this device will result in a considerable saving of oil, since none of the oil applied to the rod is wasted as is the case when swabbing or the drip cup method of lubrication is used.

An Electric Engine-Room Telegraph.

The device described below was invented for the purpose of comunicating from the bridge to the engine room on board ships. It consists of a telegraph worked electrically, thus



doing away with chains or moving wires. The movable parts are very light, consisting of an elliptical piece of soft iron mounted on an arbor, a disc of fiber and an aluminum wheel, on which are stamped the signals. The iron ellipse rotates between electro-magnets, and is locked in position by an iron core working in a solenoid. There is also a magnetic brake employed to damp the swing of the rotating parts, stopping the wheel instantly when the desired signal is in position. The receiving part of the telegraph can be made with the signals stamped on a fixed plate and a hand to indicate the signal to which it is required to draw attention. The core of the



solenoid closes an electric bell circuit, causing the bell to ring every time that the lever of the telegraph is moved. The instrument can, of course, be used for other purposes, and it could be made to repeat or a bell could be run from the engine-room to signify that the signal had been received. As it is impossible for the signal to remain in an indeterminate position this would be sufficient.

This device is being placed on the market by Walter P. Notcutt, 8 White street, Moorfields, London, E. C.

PERSONAL.

Commander Harold P. Norton, U. S. N., for nearly four years chief of the designing division of the Bureau of Steam Engineering, Navy Department, at Washington, was relieved

of the foregoing duty on May 1 and assigned to take up the duties as assistant in the office of the "Aid on Inspections," one of the four new branches in naval administration created under the Secretary of Navy's reorganization plan. Commander Norton is succeeded by Commander C. W. Dyson, with Lieut.-Commander John Halligan as assistant.

Rear Admiral Philip Hichborn, U. S. N., retired, former Chief Constructor of the Navy, died at his home in Washington, May 1. He was born at Charlestown, Mass., March 4, 1849, and was graduated from the Boston High School at the age of sixteen. Shortly afterwards he was indentured to the Government as a shipwright apprentice at the Charlestown navy yard. In August, 1861, he obtained a position as carpenter of the clipper ship *Dashing Wave,* bound for San Francisco. While on the Pacific Coast the former chief constructor was connected with the Pacific Mail Steamship Company and the California Navigation Company. He soon, however, again entered the Government service, and was assigned to the Mare Island Navy Yard. While on duty at the League Island Navy Yard in Philadelphia as naval constructor in 1884 he was detailed to make an inspection of foreign dockyards. This investigation covered a period of nearly five months. He was then ordered to Washington as assistant to the chief of the Bureau of Construction and Repair and as naval constructor at the Washington Navy Yard. He was appointed chief constructor in 1898. Some of his more noted achievements consisted in the introduction in the navy of fireproofed woodwork and the design of an inclined turret extensively copied in foreign navies and largely used in America.

TECHNICAL PUBLICATIONS.

The Marine Steam Engine. Tenth edition. By R. Sennett and H. J. Oram. Size, 6 by 9 inches. Pages, 502. Illustrations, 414. New York, 1909: Longmans, Green & Company. Price, $6.

So popular has this work become that a new edition has appeared every two years for the last eight years, and with each edition certain additions are made to bring the book thoroughly up to date. In the present edition, the additions of particular interest are in connection with the chapters dealing with the steam turbine and the torsion meter. The first two editions of the book were written by the late Mr. Richard Sennett, but after his death, owing to the great changes which had taken place in marine engineering, it required to be practically rewritten in order to modernize it. This task was undertaken by Henry J. Oram in preference to preparing an entirely new work, but, on account of the many revisions and additions, little now remains of Mr. Sennett's work. As showing the rapid development of marine engineering in recent years, it is noteworthy that since Mr. Oram's first association with the book camplete chapters on watertube boilers, oil fuel arrangements, internal combustion engines and the marine steam turbine have been added. Considerable attention is given to the care and management of marine engines and boilers, and, taken altogether, the work is one of the most complete and valuable treatises on marine engineering which is available.

Scientific American Handbook of Travel. Compiled and edited by Albert A. Hopkins. Size, 5 by 7¼ inches. Pages, 503. Illustrations, 500. New York, 1910: Munn & Company, Inc. Price, flexible cloth, $2 net; full leather, $2.50 net.

To the uninitiated traveler a sea voyage is a novelty, and either through lack of knowledge or through misinformation he sometimes fails to make suitable provision for his own comfort, which with a little forethought he might easily have done. This book gives more information regarding sea travel to-day than any other which has been published in recent years. In addition to this, it is a valuable guide book for European travel. It is not intended to take the place of descriptive guides like Baedeker, but it will be found an almost indispensable complement to such books. Among things of interest to the sea traveler, the book describes what is going on shipboard from the lookout and captain's bridge to the submarine bell detector on the keel. The personnel and its officers and men are minutely described, also the question of supplies, fees, etc., are adequately treated. A statistical and historical account of steam navigation, the size, tonnage, speed records, number of passengers landed, etc., are given. Detailed information is given as to the sea and its navigation; distances visible at sea, lights, signals, international code, wireless, semaphores, etc. The book should be of interest not only to the traveler but also as a reference book for the library.

The Story of the American Merchant Marine. By John R. Spears. Size, 5¼ by 7½ inches. Pages, 340. Illustrations, 16. New York, 1910: The Macmillan Company. Price, $1.50.

This book cannot be considered a complete history of the American merchant marine. It is rather a study of the reasons for the growth and decline of shipping in the United States. The author points out in a clear manner how in the early history of the country the people, particularly in New England, naturally turned to the sea as a profitable means for employment, both for fishing and trading. American sailors in those days were more than seamen; they were very apt to be shipbuilders, fishermen, seamen, traders and inventors as well, men who not only were daring and skillful navigators but also shrewd traders capable of meeting the competition of the keenest merchants in the world. It was due largely to the fact that the seaman was also a merchant that the carrying trade received such an impetus in the early history of the nation. In those days, in spite of almost overwhelming odds, young men having ambition and ability worked their way to the command of ships before they were old enough to vote, and it was to this opportunity to cultivate an ambition for a seafaring life that the author attributes the development of the master mariner who, in later years, made the American flag supreme upon all the seas of the whole world through the medium of the famous clipper ships. All through the book the author emphasizes the fact that the supremacy of any nation upon the sea is a matter of the survival of the fittest, disclaiming the idea that any successful merchant marine is to-day upheld by government aid or protective measures.

As to modern conditions, the author attributes the decline of the American merchant marine very largely to the blind policy of neglecting to adopt modern developments in steam engineering at a time when the steamship was displacing the sailing vessel, as instances of which he quotes the adherence of American designers to paddle wheel propulsion when other nations were turning to the screw propeller and also the lack of experience of early marine engine designers.

The author opposes subsidy as a means of upbuilding the American merchant marine, and states that if one-half the ingenuity and energy that have been used in arguing for the subsidy policy had been expended in evolving a revolution-making type of ship, America would have had long since a merchant marine worthy of her flag. The author's idea of a revolution-making type of ship seems to be the gas-driven ship, and he takes American marine engineers to task for not producing out of hand such an epoch-making ship. As a mat- of fact, American gas engine practice is not only keeping pace with the world but, in many instances, anticipating developments elsewhere. We venture to predict that if the gas-

driven ship becomes a reality the United States will be one of the first to make it so.

It is admitted that the American flag can be restored to the high seas if the nation is willing to buy ships and pay for their maintenance, but the author claims that such a procedure would be useless except as a provision for a naval reserve and that the Stars and Stripes will never again be triumphant upon the high seas until the American environment evolves once more by natural processes the nautical unit as efficient for the modern day as was the American sailing ship in days long past.

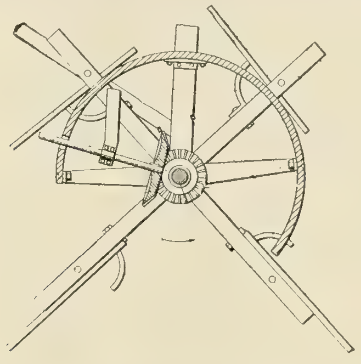
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

949,887. PADDLE-WHEEL. HENRY DUSEK, OF CAMERON, TEX.

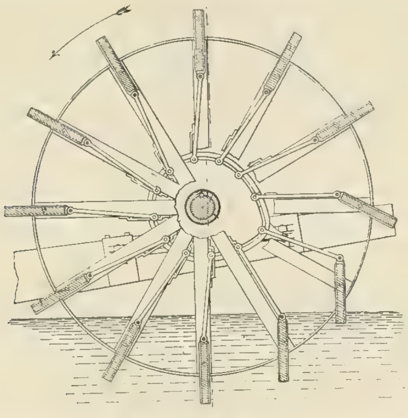
Claim 1—In a propeller the combination with a rotatable shaft; of a frame having one side portion keyed to said shaft, and the opposite side portion extending to a point adjacent said shaft, a blade pivoted be-



tween the sides of said frame, and a deflector arranged beneath the short side of said frame and in the path of movement of said blade. Five claims.

950,981. PROPELLER-WHEEL. CHARLES T. WOODBURN, OF MUNHALL, PA.

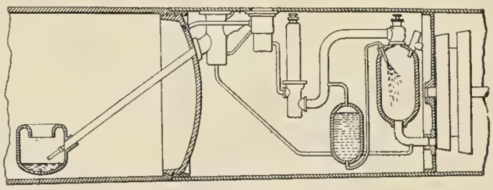
Claim 1.—In a propeller wheel, the combination with supporting beams, an axle journaled in bearings on said supporting beams, hubs carried by said axle, and a plurality of spokes carried by said hubs, of transverse blades trunnioned between said spokes, links pivotally connected at one end to said blades, wrist pins carried by said links at the free ends thereof, cams loosely mounted upon said hubs and having cam grooves formed therein to receive said wrist pins, a disk mounted sta-



tionary upon each hub, a clutch disk loosely supported by each hub, latch levers pivotally connected to the clutch disks, brackets carried by said supporting beams, latches pivotally mounted in said brackets and having the outer ends of said latch levers pivotally connected thereto, projecting arms carried by said cams to engage with said brackets, and means interposed between said cams and said clutch disks for frictionally engaging the latter with the stationary disks. Two claims.

950,550. AIR HEATER FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, N. Y., A CORPORATION OF WEST VIRGINIA.

Claim 1.—In an automobile torpedo, a compressed air reservoir, an engine, an intervening reducing valve, and means beyond said valve for heating the air under reduced pressure in its passage from the reservoir

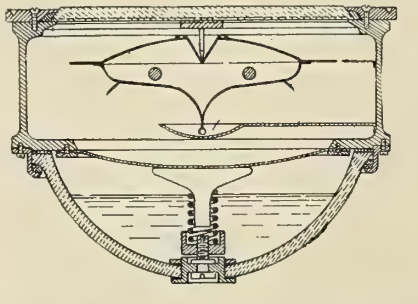


to the engine, combined with means for heating the air in the reservoir during the latter portion of the run whereby to expel a greater portion of the residual air. Seven claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

19,057. MAGNETIC COMPASSES. KELVIN AND JAMES WHITE, LIMITED, OF GLASGOW. L. W. P. CHETWYND, MILL HILL, AND F. W. CLARK, GLASGOW.

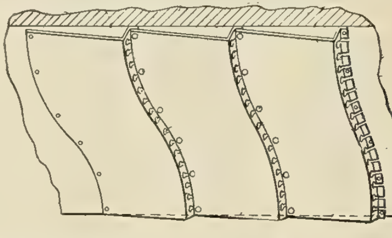
This invention relates to "liquid" compasses, in which the card is formed so that it shall resist any tendency to rock. The novel feature of the invention consists in forming that part which sustains the card of a section approximating to that of the mid-ship section of a ship. The under half of the float is thus built to give a steady platform, the curvature of the under half being partly concave and partly convex. To afford the maximum resistance to any tendency to rock the card out



of its plane, a ring is fitted around the under half of the float, to serve the purpose of a bilge keel, and to prevent the card from being thrown off its pivot, a cup-like device is provided serving as a guard which cooperates with a ball or weight at the under extremity of the card, and which is supported by means of a spring arm projecting from the side of the compass bowl. The needles may be wholly enclosed within the float, so that they are sheltered against the drag of the liquid when the vessel turns rapidly.

2,776. MEANS FOR THE REDUCTION OF WATER FRICTION ON THE SUBMERGED SURFACE OF SHIPS AND OTHER VESSLS. T. O. SMITH, SOUTHAMPTON.

According to this invention, vessels of ordinary construction are supplied with a sheathing such that their external surface may be of a form for reducing the water friction, the sheathing consisting of plates at one edge bent inwardly approximately at right angles to form a shoulder or



step, and then longitudinally to form a flange, the step being perforated with holes, and the flange provided with slots. The plates are applied so that the plain edge of one plate overlaps the flange of the shoulder or step of the next plate toward the bow and is fastened through the flange to the skin of the vessel.

7,837. MARINERS' COMPASSES. M. MUCH, DRESDEN, SAXONY.

In this device an electric circuit connects secondary compasses with a main compass and is closed and interrupted through the influence of light rays on selenium cells arranged in the circuit, the deflection of the magnetic needle causing a successive illumination of the cells. As the needle is constant in one direction, the position of the light chamber, relative to the cylinder connected to the needle, will alter with the course of the ship. At every 5 degrees the selenium cells will, in rotation, be exposed to the light of the objectives. The electrical resistance of selenium being weakened by light, the relays will respond to the light contact and switch on the electromagnets by means of the contacts. Every light contact of the main compass therefore results in a corresponding magnetic contact in the secondary compass and causes the needle of the latter to move 5 degrees in the same direction as the needle of the main compass.

International Marine Engineering

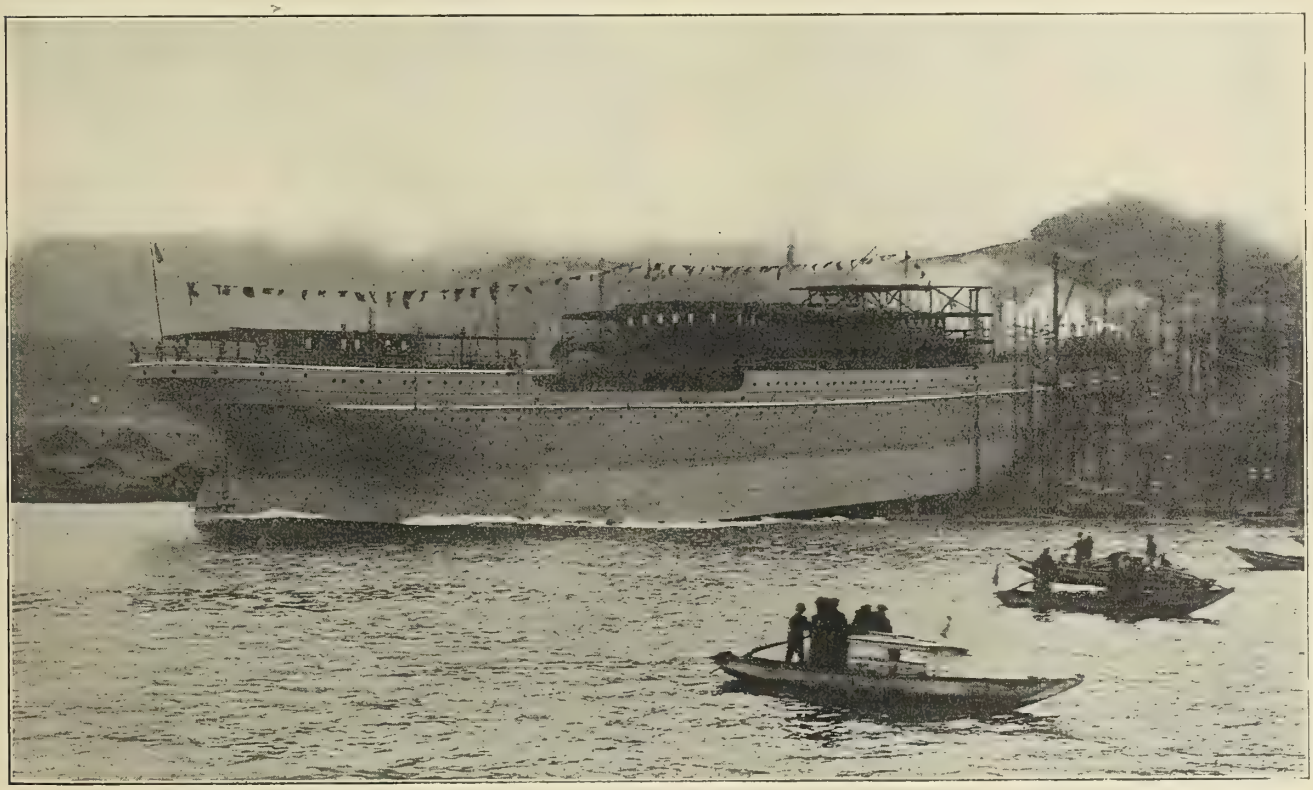
JULY, 1910.

FOUR NEW TWIN-SCREW STEAMERS FOR THE NIPPON YUSEN KAISHA EUROPEAN LINE.

The *Kamo Maru, Hirano Maru, Atsuta Maru* and *Kitano Maru,* constructed by the Mitsu-Bishi Dockyard & Engine Works, Nagasaki, Japan, are the latest additions to the rapidly growing European line of the N. Y. K., and they are typical of the last 14 years' progress of this line.

The company is the outcome of the amalgamation of the Union Transportation Company (under the patronage of the government) and the Mitsu-Bishi Mail-Steamship Company (private concern) in 1885. At that time the business of the company was principally confined to the coasting trade, but, at the time of the amalgamation, the directors were requested by the Osaka cotton merchants to extend the company's trade to India on the ground that all the Indian cottons were imported by foreign steamers at high freight rates; consequently, the company established a Bombay line and entered into competition with the P. & O. Company.

At the outbreak of the war between China and Japan all available steamers of the company were taken by the government for transports, and the company was forced to charter a few steamers from foreign owners to continue the China and India trade. However, at the close of the war, in 1895, all the steamers were returned to the company, bringing a considerable profit, and this profit was directed towards the development of the company, the first step being the construction of six new steamers of 6,000 tons each. Five of these steamers were built in foreign yards, but, in order to encourage the development of shipbuilding in Japan, the order for one of them was placed with the Mitsu Bishi Dockyard & Engine Works. Just at this time, the Japanese Government entered upon the policy of granting extensive subsidies to aid the shipping industry, and from this date the development of both shipping and shipbuilding increased very rapidly. The Nippon Yusen Kaisha immediately ordered six more steamships, and the subsequent remarkable development of the company is attributed largely to the good-will of the nation in granting liberal subsidies in spite of financial difficulties. Table I. shows a list of this company's steamers arranged in chronological order, and gives a good idea of the development of the company.



LAUNCH OF THE KITANO MARU.

Table II. gives more fully the particulars for the new ships.

GENERAL ARRANGEMENT.

Entering now into the description of the vessels, they are constructed generally of steel to Lloyd's requirements of the

highest class, and are subdivided into eight compartments by watertight bulkheads, with a cellular double bottom from stem to stern. There are six decks, known as the lower, main, upper, bridge, promenade and boat decks. The lower deck extends through only the fore part of the vessel, while the next two decks, the main and upper, run from stem to stern. The bridge deck extends 178 feet in the central part, having a poop 80 feet long and a forecastle 54 feet long. Above this level there is in the central part of the ship the promenade deck, 138 feet long, and aft there is an aft boat deck, 56 feet long. The boat deck proper covers the entire length of the promenade deck, with the navigation bridge at the fore end.

At the fore end of the boat deck there are located the wheel house, chart room and captain's room, having a light and ventilating shaft for the main dining saloon, while around there is sufficient promenade room for the use of officers. Ten boats are stowed on this deck, affording a means of splendid promenade space on the deck below. The remaining boats are stowed on the aft boat deck, which also serves a means of minimizing interference with the promenade space on the poop deck. All boats are fitted with Mill's patent instantaneous engaging and disengaging gears. At the aft end of the boat deck there is the engine room skylight, also the clerestory skylight for the first class smoking room.

The promenade deck is interesting, because this deck is entirely allotted for the principal public rooms and the promenade space. There is a steel house extending almost the entire length, with a broad and spacious promenade around it, yet under the cover of the boat deck. The drawing room and social hall occupy the forward end of the house, having a companion way leading down to the bridge deck accommodation. The mid portion of the house is taken by the machinery, and at the aft end there is a first class smoking room, 24 feet by 28 feet.

The bridge deck is also used entirely for first class passenger accommodation. The deck house, which occupies practically the full length of the deck, has on each side staterooms of an exceptionally capacious and lofty character; to accommodate two persons in each. At the fore end of the house there is a large well, conveying light and air to the main dining saloon on the upper deck below. This light and ventilating well has been most ingeniously treated and serves to add to the decorative effect. This pierces the deck above through the drawing room and social hall, and through the boat deck house, and terminates with outer skylight on top of the navigation bridge; but in the boat deck house is a charmingly-designed stained glass dome of highly decorative character. Abaft the well there is a main stairway leading to the promenade deck above and to the dining saloon below. Ample natural light is provided in way of the staircase by means of a large and handsomely designed trunk skylight. At the aft end of this house there is companion way to the smoking room. The remaining space in this deck house has been devoted to bath rooms and lavatories.

The poop deck is given over to the second class passengers. There is a deck house on the poop, having at the forward end the second class smoking room, and at the aft the second class cabins, the latter adjacent to the companion way leading to the second class dining saloon and cabins below. One of the second class cabins on the poop deck is designed so that it may be easily turned into a wireless telegraph room, should occasion demand.

The forecastle deck is fitted with a strong breakwater, and carries the most approved equipment for handling the vessel safely and expeditiously.

The upper deck under the bridge deck contains a large number of cabins for officers and engineers; there is also the main dining saloon forward of these rooms; the first class pantry is immediately abaft it. Aft of the dining saloon there

TABLE I.

LIST OF N. Y. K. STEAMERS BUILT FOR EUROPEAN AND AMERICAN LINES.

Date of Launching.	Ship's Name.	Dimensions.	Gross Tonnage.	Speed.	Builder's Name.
1896	Kanagawa Maru	445′ x 49′ 2″ x 33′ 6″	6,169	14.48	D. W. Henderson & Co.
1897	Hakata Maru	445′ x 49′ 2″ x 33′ 6″	6,161	14.61	D. W. Henderson & Co.
1897	Kawachi Maru	445′ x 49′ 2″ x 33′ 6″	6,101	14.80	Napier Shanks & Bell.
1897	Wakasa Maru	445′ x 49′ 2″ x 33′ 6″	6,265	14.93	D. W. Henderson & Co.
1897	Kamakura Maru	445′ x 49′ 2″ x 33′ 6″	6,126	15.43	Workman Clark & Co.
1897	Sanuki Maru	445′ x 49′ 2″ x 33′ 6″	6,112	14.41	Napier Shanks & Bell.
1897	Inaba Maru	445′ x 49′ 2″ x 33′ 6″	6,189	14.59	D. W. Henderson & Co.
1897	Tamba Maru	445′ x 49′ 2″ x 33′ 6″	6,134	14.59	Napier Shanks & Bell.
1897	Bingo Maru	445′ x 49′ 2″ x 33′ 6″	6,247	14.46	D. W. Henderson & Co.
1898	Hitachi Maru*	445′ x 49′ 2″ x 33′ 6″	6,172	14.18	Mitsu-Bishi.
1898	Sado Maru†	445′ x 49′ 2″ x 33′ 6″	6,227	15.30	Workman Clark & Co.
1899	Awa Maru	445′ x 49′ 2″ x 33′ 6″	6,309	14.82	Mitsu-Bishi.
1900	Shinano Maru	445′ x 49′ 2″ x 33′ 6″	6,388	15.39	D. W. Henderson & Co.
1901	Kaga Maru	445′ x 49′ 2″ x 33′ 6″	6,301	15.51	Mitsu-Bishi.
1901	Iyo Maru	445′ x 49′ 2″ x 33′ 6″	6,320	15.32	Mitsu-Bishi.
1903	Aki Maru	445′ x 49′ 2″ x 33′ 6″	6,444	15.33	Mitsu-Bishi.
1905	Tango Maru	445′ x 52′ x 33′ 6″	7,463	15.63	Mitsu-Bishi.
1906	Hitachi Maru	445′ x 52′ x 33′ 6″	6,716	15.68	Mitsu-Bishi.
1908	Kamo Maru	465′ x 56′ x 34′ 6″	8,524	16.41	Mitsu-Bishi.
1908	Hirano Maru	465′ x 56′ x 34′ 6″	8,521	16.58	Mitsu-Bishi.
1908	Mishima Maru	465′ x 56′ x 34′ 6″	8,500	16.56	Kawasaki Dockyard.
1908	Miyazaki Maru	465′ x 56′ x 34′ 6″	8,500	16.35	Kawasaki Dockyard.
1908	Atsuta Maru	465′ x 56′ x 34′ 6″	8,523	17.01	Mitsu-Bishi.
1909	Kitano Maru	465′ x 56′ x 34′ 6″	8,512	17.19	Mitsu-Bishi.

* Sunk in Russo-Japanese war 1904.

† Torpedoed in Russo-Japanese war 1904, but repaired by Messrs. Mitsu-Bishi Dockyard & Engine Works.

TABLE II.

PRINCIPAL DIMENSIONS OF NEW SHIPS.

Name.	Kamo Maru.	Hirano Maru.	Atsuta Maru.	Kitano Maru.
Length between perpendiculars	465′	465′	465′	465′
Breadth molded	56′	56′	56′	56′
Depth molded	34′ 6″	34′ 6″	34′ 6″	34′ 6″
Gross tonnage	8,524	8,521	8,523	8,512
Draft	27′ 0¾″	27′ 0¾″	27′ 0¾″	27′ 0¾″
Dead weight	9,501	9,519	9,331	9,304
Speed	16.41	16.58	17.01	17.19
No. of first class passengers	83	83	83	83
No. of second class passengers	32	32	32	32
No. of intermediate passengers	12	12	12	12
No. of steerage passengers	138	138	122	124

[In *Atsuta Maru* and *Kitano Maru* a great many extra weights were worked into the vessels.]

are more staterooms, one of which is specially large and furnished superior to other staterooms, and may be styled as the cabin de luxe of the ship. There is also a photographic dark room on this deck.

The galleys are located at the aft end of the bridge house; all the arrangements for the serving of meals are modern and cuisine appliances are complete and up-to-date, but entirely free from the patent collections which are too often seen in modern steamers.

A point which draws our attention in the arrangement of this portion of the upper deck is that the starboard side of the ship is given up for chief steward, purser, doctor, dispensary, barber shop forward, and to officers' rooms aft; the corresponding cabins on the port side are arranged for officers' and engineers' mess rooms forward, and engineers' rooms aft. The first class passenger accommodation at the fore end of the house is divided off from these spaces by doorways, so that the officers and engineers are entirely separated from the passengers; and, moreover, for engineers the accommodations are contiguous to their work. The location of the doctor's room and dispensary is particularly good and convenient for all classes of passengers and crew, also the location of the barber shop, between the first and second class quarters, makes it convenient for both classes of passengers alike.

The deckhands are berthed forward under the forecastle, which is equipped in the most approved manner, while the dining saloon and cabins for the second class passengers, also cabins for the junior officers and laundry, are under the poop.

The lavatories are fitted with the most approved sanitary arrangements, and instead of being arranged in large compartments they are distributed throughout all the living quarters. The floors are laid with black and white encaustic tiles. All the baths for the first class passengers are of Vic-

torian porcelain. The sanitary appliances are supplied by Messrs. Shanks & Co., Ltd. The first class staterooms are fitted with patent berths, supplied by Messrs. Hoskin & Son, Ltd.

The intermediate and third class passengers are accommodated on the main deck forward, the firemen and waiters are berthed aft on the same deck; thus the firemen may go to the machinery space or back to their sleeping quarters without passing by any part of the ship given up to the passengers.

Aft the machinery space, a cold chamber has been provided; this chamber is not for carrying frozen cargo, as this is not necessary in this line of trade, but only for providing the fresh provisions for the ship. The chamber includes two meat rooms, one fish room and one fruit and vegetable room, and has a capacity of 2,800 cubic feet. The plant is capable of maintaining the temperature of the chamber at not over

READING ROOM ON THE ATSUTA MARU, LOOKING AFT.

26 degrees F., when passing through the tropics, with the machinery working not over 6 hours out of 24. It is at the same time capable of producing three hundredweight of ice for table use. The plant is supplied by Messrs. J. & E. Hall, Ltd.

The remaining part of the main deck is given up for cargo, bunkers, silk rooms, parcel room, mail room, baggage room and provision rooms.

The lower deck and holds are entirely given up for cargo.

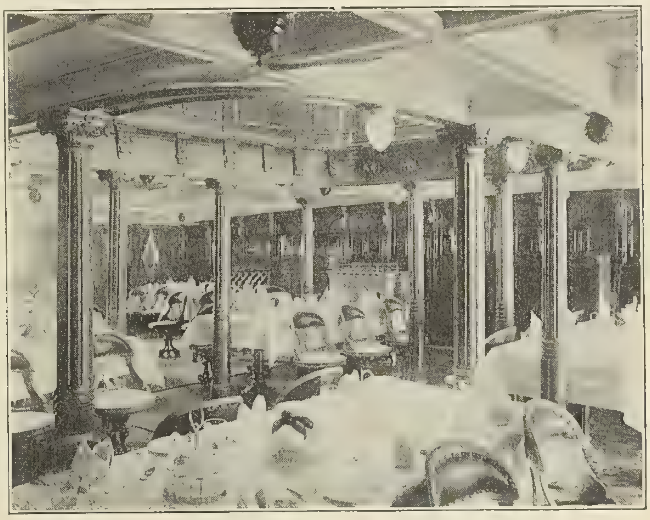
STERN FRAMING.

Referring again to the structural details of the vessel, the ship is propelled by twin screws, and these are supported at their outboard end by a cast steel spectacle piece attached to the stern frame. The shafting is contained entirely within the framing of the ship, and for this purpose the framing is bossed out in spectacle form. The stern frame has a screw port, as in the single screw arrangement, although the propellers are not of the overlapping design, but this is done to minimize the projection of the propellers outboard, which also minimizes the amount of bossing for the framing. A screw aperture for twin screws, with overlapping propellers, as we all know, was adopted first in the former Atlantic greyhounds *Teutonic* and *Majestic,* by Messrs. Harland & Wolff; nevertheless, in many instances, it is of greatest advantage to have this screw aperture with an ordinary twin-screw wheel, especially when the propellers are of large diameter, so as to reduce the resistance of the bossing.

The stern frames, spectacle pieces and rudders were supplied by Messrs. Darlington Forge Company, Ltd. The rudder is worked by a steam-steering gear, by Messrs. Caldwell & Company, Ltd. This gear is placed on the upper deck under the poop, and actuated from the navigation bridge; it is fitted with Hastie's patent friction brake. Hand gear is also fitted to the rudder head on the poop as a stand-by.

DECORATIVE FEATURES.

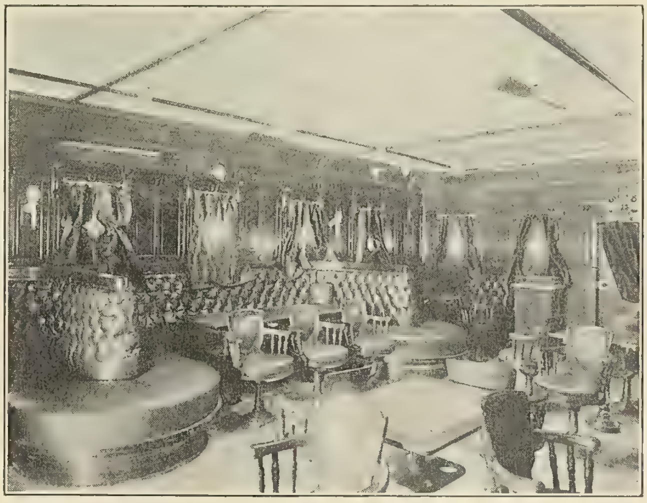
All four of these vessels were worked out alike in general decorative design, with but a slight modification. *Kamo* and



FIRST CLASS DINING SALOON OF THE KAMO MARU, LOOKING FORWARD.

Hirano are of the same design, and *Atsuta* and *Kitano* are of the same design, therefore in this case we will confine ourselves to a description of the *Atsuta Maru.* Before going any further, it may be well to say that all of the decorative work in these ships has been designed at the builder's works, where also the work was completed.

The first class drawing and social hall are adjacent to each other, and directly communicating with the main companion way. The drawing room is finished in white, relieved by pale green silk panels, with autumn wild flower design and with paneled dado of polished white beech. The furniture is of



FIRST CLASS SMOKING ROOM OF THE ATSUTA MARU.

white beech and maple, and the upholstery is of dark green silk damask; the curtains and other hangings are also of dark green. The floor is laid with Wilton carpet of green shade. A Broadwood grand piano occupies a corner in the drawing room. The side of the well is decorated with art-glass, in nickel-plated framework. The social hall is treated in exactly the same way as the drawing room.

The first class smoking room, at the aft end of the promenade deck, is treated after the old Japanese style, moderated to suit the modern European architecture with stained oak, and the floor is of interlocking rubber tiles. The upholstery is of dark maroon, and the hangings are of Japanese tapestry of subdued and quiet brown shade, with a classic pattern, becoming to the general design of the room. The roof is constructed in the clerestory style, with a large skylight having light-colored stained glass. The whole effect is very pleasing and in marked contrast to the somewhat garish decoration too often adopted in the modern steamer. The ventilation of the room, by means of electric fans, is very effective.

The first class dining saloon, which is on the upper deck, occupies the full width of the ship and is 32 feet long; seating accommodation is provided for 68 passengers, so that all the first class passengers may dine at one sitting. One commendable feature is that instead of placing the great majority of the passengers at long central tables, they are arranged, as in most modern liners, at a number of small tables, seating not more than seven persons. The saloon is finished with plain, polished oak, relieved with carved molding, the pillars being ornamented with carved head pieces. The upholstery is of dark green and the hangings are of gold on dark green ground. The floor is parquetted with brown Wilton runners on top. There is an upright piano of Broadwood make at the fore end of the saloon.

Electric fans have been substituted for punkahs over each table. The central well, while the main decorative feature, serves to further facilitate ventilation and has a length of 12 feet, and a width of about 9 feet, having at the top, as is already stated, a stained glass dome.

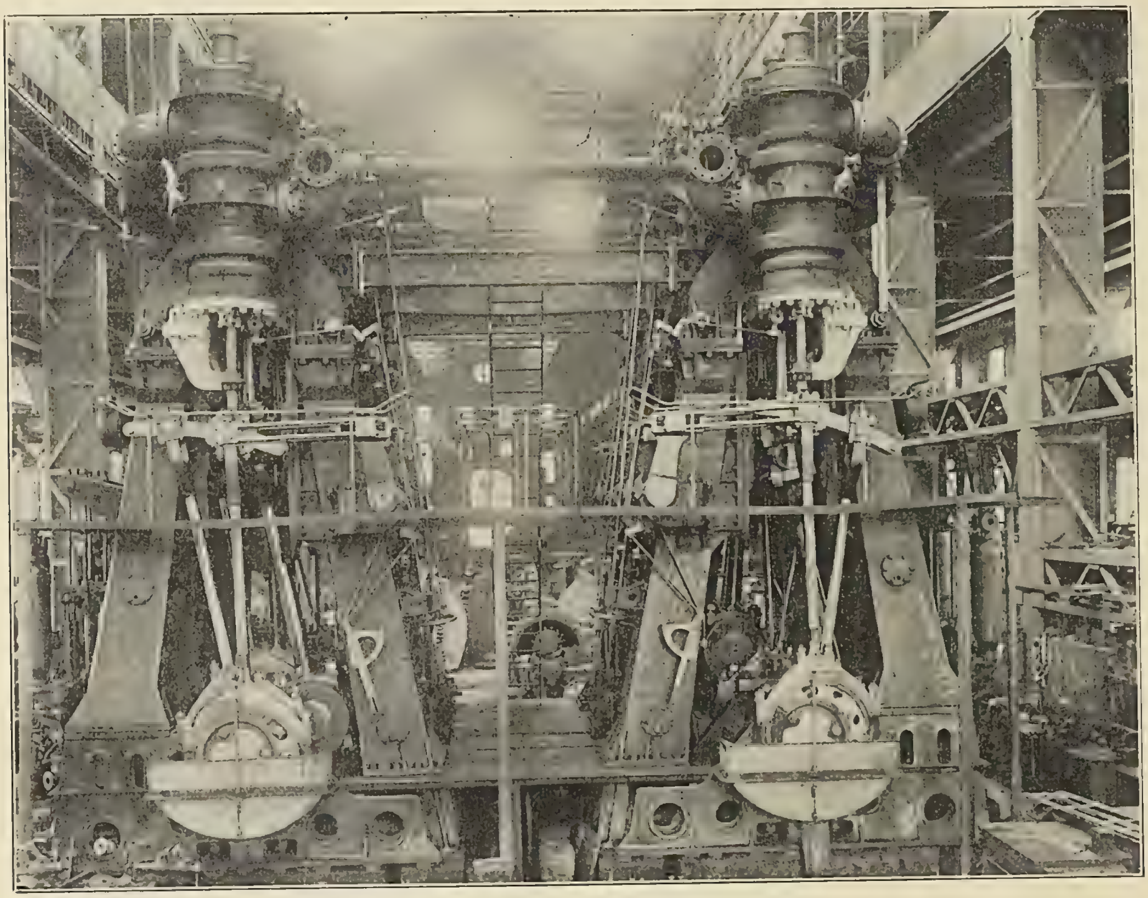
The vestibule on the promenade deck and entrance hall on the bridge deck are paneled and framed in oak, and the floors are covered with neatly designed interlocking rubber tiles.

ELECTRICAL INSTALLATION.

The generating plant is located in the tunnel recess and includes two sets, each giving an output of 35 kilowatts when running at 300 revolutions per minute. The engines are of the self-lubricating type, and the dynamos are six pole compound wound. The current is transmitted by insulated cable of high conductivity, all wiring done in the double wire distributing box system. These machines, in addition to lighting the ship, provide current for driving 13 36-inch ceiling fans for ventilating the first class dining saloon, 5 in the smoking room, 4 in the social hall, 4 in the drawing-room, 4 in the second class dining saloon, and 2 in the second class smoking-room. Also they drive 14 18-inch fans for ventilation of holds and 42 12-inch bracket fans for the first class cabins. There are throughout the ship lights equal to 8,022 candle power, and in addition 10 cargo lamps of 200 candle power each, 2 arc lamps of 3,000 candle power each, and one searchlight projector of 16,000 candle power. The main switchboard has 9 circuits, 6 for the lighting of the ship, 1 for the fan motors, and 1 for the search-light projector. The engines and dynamos, fan motors and all fittings for the installation are of the builder's own design and make, and fitted complete on the ships by the builder's own hands.

As regards the telephone service, there is on the navigation bridge a telephone communicating with the engine-room, the lookout at the forecastle, and the docking orders at the aft boat deck. Telephones are of a pillar type and of the loud-speaking marine pattern of Graham's make.

While the vessel is finished as a first class passenger



MAIN ENGINES OF THE ATSUTA MARU IN THE ERECTING SHOP.

steamer, the cargo carrying capacity of the vessel is of greatest importance in this line, and for dealing with the 6,000 odd tons of net cargo with facility and safety, the utmost attention and care have been exerted both by the owners and builders in the design and construction. Ten derricks are provided, four of 10 tons capacity, and the others of 6 tons. In addition to these there is fitted one heavy derrick capable of lifting 40 tons weight, with topping arrangement. This derrick is worked by two 9 by 16-inch steam winches working on one drum and one hoisting winch for topping worked by the messenger from the steam windlass. Besides these winches there are 8 steam winches for working other derricks. All winches are of the builder's special pattern and make.

The steam windlass with capstan is of Messrs. Napier Bros., Ltd.; it is fitted with the maker's patent self-holding brake. One steam warping capstan by Messrs. Clarke, Chapman & Company is also fitted on the poop.

Ship's telegraphs were supplied by Messrs. Chadburn & Son.

A complete system of water supply is distributed throughout the ship, maintaining the continuous supply of cold fresh water and hot and cold salt water, not only to all the sanitary quarters, but also to various galleys, pantries, sculleries, etc.

PROPELLING MACHINERY.

The vessel is fitted with a twin set of triple expansion engines, each set having the high-pressure cylinder 25 inches in diameter, the intermediate 41½ inches in diameter, and the low-pressure 69 inches in diameter; the stroke in all cases is 48 inches and the working steam pressure 200 pounds per square inch.

The high-pressure cylinder is fitted with piston valves, and the intermediate and low-pressure cylinders with slide valve, that of the intermediate-pressure cylinder being a special slide valve balanced, known as a square piston valve. The packing rings for the high-pressure and intermediate-pressure cylinders are of the Ramsbottom type, provided with restricted movements. The packing for the low-pressure cylinder is of simple design, so that spare springs may be easily procured.

Box columns are adopted, one of which forms a hot well and the air vessel of the air pump; others serve as reservoirs for lubricating oil.

The condenser is of strong cast iron, with rolled gunmetal tube plates, and tinned solid drawn brass tubes. The top of condenser is specially shaped so that the exhaust steam from the engine flows uniformly over all the tubes.

All the working parts of the engine are made to standard gage, so that the minimum of spare gearing is necessary. All the working parts of the engine are of ingot forged steel, while the propeller shafts are of patent lockfast iron.

The propellers are right and left handed screws, each with four blades, of Stone's manganese bronze. After a series of trials the propellers proved to be of the highest efficiency, and reflect the experience and ability of the designer.

AUXILIARY MACHINERY.

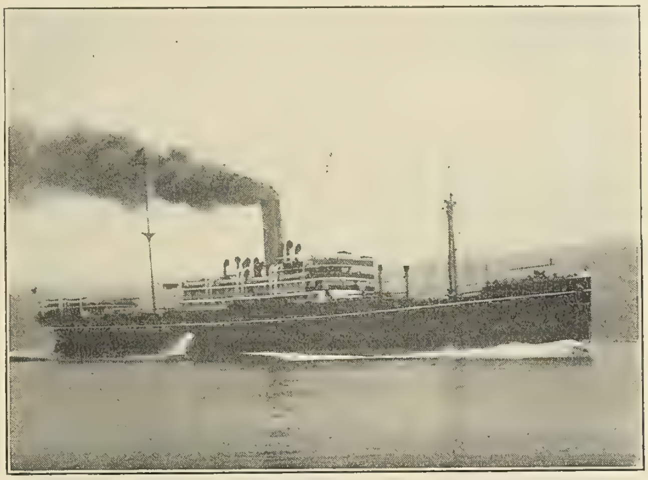
The various auxiliary appliances are as follows: Edwards' patent single acting air pump, Weir's patent feed heater and automatic pumps, circulating pump, feed water filter, auxiliary condenser of Morison's contraflo type, also pumps for sanitary purposes, for washing deck and fire extinguishing and for fresh water for passengers' use. There are also bilge and ballast pumps. The distilling plant consists of one large Weir's evaporator capable of producing from sea water 40 tons of fresh water per 24 hours, and one distilling condenser having an output of 7,000 gallons of pure fresh drinking water per day. The engine compartment, notwithstanding the completeness of all auxiliary appliances, is very roomy.

BOILERS.

The boilers are arranged in one compartment. There are six single-ended boilers; each boiler is 14 feet 3 inches in diameter and 11 feet 6 inches long. Each has three furnaces of the Morison bulb suspension type, the internal diameter of the flues being 3 feet 5 inches. The boilers are worked at a pressure of 200 pounds to the square inch, and are on the Howden's forced draft system.

Two fans are fitted, each having one special high speed single cylinder double acting engine of open type and capable of working all boilers when the main engines are running at 5,500 indicated horsepower on service.

There is one round, large funnel, 12 feet 9 inches in diameter and rising to a height of 110 feet above the keel of the vessel. The funnel is double, the space between the inner and outer funnels being utilized for ventilating the boiler room and stokeholds. The provision for the disposal of the ashes has



KITANO MARU RUNNING HER FULL SPEED TRIAL.

been made by fitting two powerful See's ash ejectors, one in each stokehold, worked by a special donkey pump.

TRIALS.

In all cases the full speed trials were run on the measured three-mile government course outside of Nagasaki harbor under the supervision of the government officials. The following table gives the results of those runs:

MEAN RESULTS OF FULL SPEED TRIALS OF KAMO MARU, HIRANO MARU, ATSUTA MARU AND KITANO MARU.

	Kamo Maru 6 16 1908		Hirano Maru 11 16 1908		Atsuta Maru 2 15 1909.		Kitano Maru 4 12 1909.	
Number of runs.	Speed.	Revolutions.	Speed.	Revolutions.	Speed.	Revolutions.	Speed.	Revo. lutions
1 down	16.554	93.00	16.510	93.25	16.687	98.25	17 053	96.0
2 up	16.284	93.5	16.621	93.25	17.387	97.75	17.218	97.25
3 down	16.594	93.5	16.532	93.75	16.710	98.25	17.194	97.38
4 up	16.467	93.5	16.598	93.75	17.314	97.75	17.266	97.0
5 down	16.105	90.5	16.598	93.50	16.621	97.5	17.030	96.0
6 up	16.084	90.25	16.554	93.75	17.266	97.5	17.194	96.25
Mean of means	16.41		16.57		17.00		17.19	

Lastly, but most important above all, it is claimed that in service all the four vessels have proved themselves most economical in working and given every satisfaction to the owners.

The Bureau of Navigation reports 117 sail and steam vessels of 37,689 gross tons were built in the United States and officially numbered during the month of May, 1910. Seven steel steamers aggregating 25,679 gross tons were built on the Great Lakes, and two steel steamers, aggregating 6,741 gross tons, on the Atlantic coast.

THE MARINE STEAM ENGINE INDICATOR—XII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

The preliminary tests of the indicator being now completed, remove the pencil mechanism and piston; wrap in a soft cloth, and stow away in the indicator box. Plug the indicator cylinder with a piece of cloth; attach the instrument to its proper cock on the cylinder,[1] and line up the guide pulley so

FIG. 86.

that the drum cord will coincide with the center line of the reducing-motion guide rod, and in such position that the paper clips will face the operator as nearly as possible. Pass a cord through the guide pulley and around the drum base ring, just taking enough turns to rotate the drum its full amount, but still having sufficient to prevent the drum end of the cord being pulled inside of a line passing through the guide pulley and tangent to the drum base ring. See that the turns do not ride.

A light wire hook will be found in the box with the instrument. With a pair of round-nose pliers close the eye so that the cord will just pass through without binding. Attach the hook to the drum cord about an inch below the guide pulley by means of the hitch shown in Fig. 86, the part shown in dotted lines being omitted. Take another piece of cord and make a single bowline on the end (Fig. 87)[2]. Hook the bow-

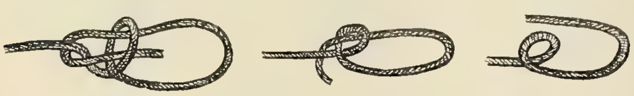


FIG. 87.

line in the hook. Put in the turning gear and place the engine on the top center. Pass the lower end of the bowline cord through the eye in the top of the reducing-motion guide rod, and haul the cord down until the drum is clear of the stop by about ⅜ inch; take an additional turn through the eye, and make fast with two half hitches about the standing part and draw the hitches down singly, so that there can be no slipping. See Fig. 88. Unhook the cord. Turn the engine to the bottom center and hook on again. If the reducing motion is properly proportioned, the hook will come down so that it will easily engage the bowline.

The testing out of the reducing motion is now in order. Take a long, wooden batten with a section about 1 inch by 1 inch and plane two of its adjacent sides. Secure a long wood screw in one end of the batten and grind or file the head down to a point. The engine now being on the bottom center, hold one of the planed edges of the batten against the end of the cross-head or gudgeon pin, in such a manner that it will be parallel to the piston rod, and with the pointed wood screw touching the cylinder bottom at whatever point happens to be in line. Note where the wood screw touches, and mark with a center punch. Put the screw end in the mark. Draw a fine horizontal line across the end of the cross-head pin, and make a corresponding mark across the batten. Turn the engine to the top center, and make another mark on the batten opposite the cross-head mark. Take the batten down, and divide the distance between the marks into any convenient number of equal parts. Not less than eight should be used, and these are conveniently laid off by successive halvings of the original distance.

Put a paper card on the drum, replace the pencil mechanism and piston, together with a light spring. Draw a horizontal line on the card by pulling the cord. Hook the cord in the bowline, and taking hold of the drum base ring with the fingers try to rotate it against the pull of the cord. This is done to make sure that the cord is all taut.

The engine being on the top center, make a small vertical mark on the card by gently raising the pencil about 1/16 inch with the pencil in contact with the paper. Put the batten in position, and turn the engine down until the first sub-division on the batten and the cross-head mark are in line. Make another small mark on the card. Repeat the operation until the

FIG. 88.

bottom center is reached. The diagram made will resemble Fig. 89, and if all is correct the spacing of the points will be equal. The small vertical line may now be projected upward, and the spacing checked with a diagonal scale, or a pair of fine-pointed dividers can be used. The distance x should be carefully measured and noted, and the diagram preserved for future reference. Much turning of the engine will be avoided if the operation of connecting up the drum cord is performed while the batten is being marked.

If it be necessary to rig the drum-cord with the engine in motion it is easily done as follows: Attach the hook and bowline as before described. Pass the lower end of the bowline-cord through the guide rod eye, and bring the end back in itself, holding the two parts together with the thumb and finger of one hand. With the other hand shorten up the cord until the drum is in motion and clears the stop at the top of the stroke. Now, very carefully shorten up the cord until the drum again touches the stop as the engine crosses the bottom center; slack the cord back half-way and make the round turn and two half-hitches.

Stretching or slipping of the cord is not admissible if accurate work is to be done, and if the cord lead is long, wire should be used for the entire transmission except over pulleys and around the drum; and even at these points some of the flexible bronze wires will stand for a considerable time. Ordinary soft iron wire—of No. 20 to 26 Birmingham gage—is good, and some of the small braided wire cords used for hanging pictures are excellent. If wire is used it should be drawn back and forth around one of the hand rails until all the kinks are worked out. The best fiber cord is made of parallel strands of linen, protected by a braided linen cover or jacket. It should be about 1/16 inch in diameter. Two or three days before indicating, several feet of cord should be stretched ready for use. This is best done by making one end fast up

[1] The following description and directions refer to a vertical multiple-expansion engine fitted with a gear like that described in the April, 1910, issue.

[2] The reader should learn to tie these knots, as they will neither slip nor jam.

under the deck, running the cord along horizontally and over a small pulley or smooth ring at the free end, to which a 5 or 6-pound weight is made fast. If the cord is of good quality it will stretch about 1 inch in 16 feet, and no more. The stretching should be done in the engine room, where the atmospheric conditions will be about the same as when the cord is in use. While the writer prefers to use a hook with the double Blackwall hitch for adjusting the cord length, many operators like the trrangement shown in Fig. 90. If this is used the metal must be thick enough to permit of all the edges being nicely rounded. If the piece is thin, with sharp edges, the cord will be quickly cut, especially if the speed is high. The extra weight is also liable to cause vibration.

It will now be necessary to wait until the engine is under way, at full speed, before proceeding farther with our trials,

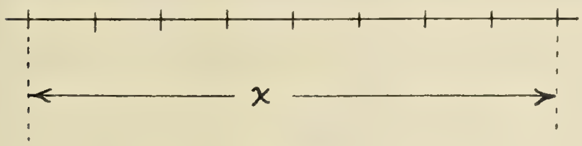


FIG. 89.

but in the meantime our cards should be made ready and the pencils put in order. Cards are of two kinds—"metallic" and plain. Metallic cards are coated with various preparations; some with a salt of lead and others with a coating of lime, whiting and size, and all of them present a fine, smooth surface. A brass or silver point drawn over a surface thus prepared leaves a fine, dark line, which is not easily erased. The surface is easily marked on with ordinary pencils, and takes ink well. The "pencil" used with this paper is simply a short piece of soft brass wire[3] worked down to a smooth, fine point. It requires some little patience to get the point so that it will draw a fine line and not catch in or scratch the paper, but once done it will last a long time. Metallic cards can be purchased from any indicator manufacturer. If plain paper is to be used a sample of the proper thing is furnished with the instrument.

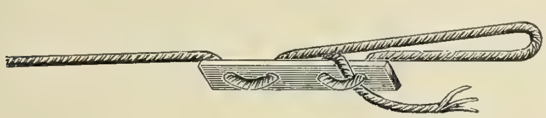


FIG. 90.

When the original cards are exhausted a quantity of cards of the proper quality and size can be purchased at any printing house. They should be blank on both sides. The necessary data, to be used in working up the diagrams, are better kept in tabular form on a separate sheet, and the cards numbered for reference. With plain paper, HHHH leads should be used. They should be pointed with a fine file and be very short, so as to reduce the weight at the pencil end of the lever as much as possible.

There are several ways of putting the paper on the drum, but the writer prefers the following method: Place the paper, face upward, on a plane surface. Fold one end flat on itself, so that the crease will be about ½ inch from the end and square with the long edges of the card. Place the folded end of the paper under the end of the longer clip, in such a position that the fold will stick out radially from the drum. Still holding the folded end by its lower corner, wrap the card around the drum with the other hand, and shove its lower edge under the shorter clip. If the card is cut to the proper length both ends will now stick out about ½ inch between the clips. Bring the two lower edges together near the ends, and grasp them with the thumb and fore finger of one hand. Smooth the card on the drum with the other hand, at the same time drawing downward with both hands. If the original fold was not exactly square, one corner will be a little higher than the other, but that is immaterial so long as the paper lies smoothly

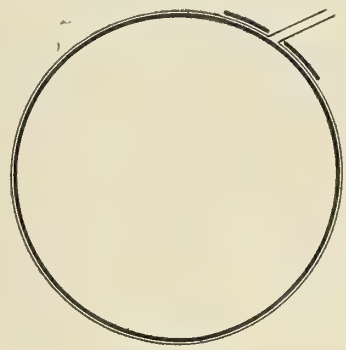


FIG. 91.

on the drum surface. A glance at Fig. 91 will make the description clearer. After ten minutes' practice the reader will be able to fit a card to the drum in a few seconds, so that it will be as close-fitting and smooth as could be desired.

The proper piston springs for the job on hand should now be selected, and as the spring is the actual measuring part of the instrument its accuracy and proper selection are of the greatest importance. If the springs which are about to be used are new, they will be correct or their error will be shown on a calibration card, which the maker will furnish if requested. If the springs have been in frequent use for a year they should be retested. If no material change is noted on this second test they may be allowed to go for a much longer period before the next calibration. The charge for spring testing varies from seventy-five cents to a dollar and a half (three to five shillings) for each spring. Fig. 92 shows a calibration

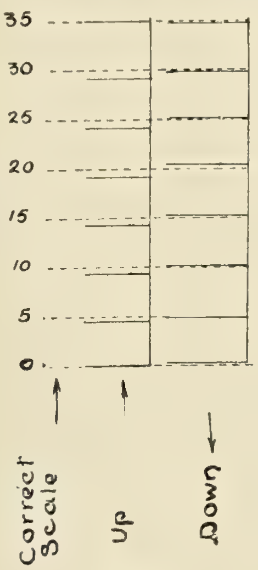


FIG. 92.

card of a 20-pound spring, which had been in use about three years previous to the test, and a glance at it will demonstrate that spring testing is not a useless refinement. The easiest cards to read are those whose height is equal to one-half the length, because in diagrams so proportioned the various events, such as cut-off, release, etc., are most sharply defined. In this connection it should be noted that the larger the card the smaller will be the percentage of error in measuring its area. To illustrate: Suppose that we have an engine working with a mean effective pressure of 40 pounds to the square

[3] A silver point makes a beautiful line, but it wears away faster than the brass.

inch, the reducing motion giving a card four inches long. If we take a diagram with a 20-pound spring its area will be $40/20 \times 4$, or 8 square inches. If a 40-pound spring is used its area will be $40/40 \times 4$, or 4 square inches. On the large diagram 1-pound pressure is represented by 8/40, or 1/5 square inch; on the small diagram 1 pound is equal to 4/40, or 1/10 square inch. If now a constant error of 1/5 square inch should be made in computing the area of both diagrams our mean pressure would be in error $1/5 \div 1/5$, or 1 pound on the large diagram and $1/5 \div 1/10$, or 2 pounds on the small diagram. On the other hand, the effects of inertia increase directly with the size of the diagram, and these should be kept in mind. A simple method for determining the magnitude of the error, due to drum inertia, will be described presently. The magnitude of the vertical distortions cannot be determined in so simple a manner. However, if the diagram does not show waves in lines which should be nearly horizontal, it may be assumed that the proper spring scale has been selected.

The reducing motion with which we are supposed to be working gives a diagram $3\frac{3}{4}$ inches long. This calls for a diagram $1\frac{7}{8}$ inches high, but as our speed is 160 revolutions per minute, let us try $1\frac{1}{2}$ inches for the maximum height. An approximate rule for finding the spring scale is as follows: From the receiver pressure, on the cylinder to be indicated, subtract the receiver pressure of the next following cylinder. Divide the result thus found by the desired height of the card in inches. Example: Let the receiver pressure be: high-pressure, 160; medium-pressure, 55; low-pressure, 16; condenser, —13 (or 26 inches vacuum). According to the rule the springs should be:

$$\text{High-pressure } \frac{160 - 55}{1.5} = 70$$

$$\text{Medium-pressure } \frac{55 - 15}{1.5} = 26.7$$

$$\text{Low-pressure } \frac{15 - (-13)}{1.5} = 18.7$$

We must now select the next nearest scale which is regularly made, and, in the case of the high-pressure, it should be generally the next higher. We should therefore try 80, 30 and 20, but no matter what result is obtained by the rule, springs should not be subjected to a pressure which will raise the pencil more than $2\frac{1}{4}$ inches above its position when at atmospheric pressure, and if a scale of maximum pressures is furnished with the instrument, such pressures should in no case be exceeded. Extracts from the tables of two indicator firms are shown on this page, and an inspection will show that they are practically the same.

MAXIMUM SAFE PRESSURES IN POUNDS PER SQUARE INCH WHEN USED WITH A HALF-INCH AREA PISTON.

Scale of Springs.	Duplex Springs.		Single Springs.	
	To 200 R.P.M.	To 300 R.P.M.	To 150 R.P.M.	To 300 R.P.M.
8	10	6	12	8
10	15	10	18	12
12	20	15	22	16
16	28	22	30	24
20	40	32	40	32
24	48	40	...	...
30	70	58	70	55
32	75	62	...	...
40	95	80	90	80
48	112	95	...	...
50	120	100	110	95
60	140	115	135	110
64	152	125	...	...
70	...	...	150	125
80	180	145	170	140
100	200	160	200	200
120	240	195	...	...
125	...	...	260	260
150	290	250	300	300
200	375	330	400	400

While the 80, 30 and 20 springs which we have selected will probably be best for the job under consideration, our outfit should include the following for each set of three indicators: One each 10, 20, 30, 40, 60, 80 and 100 scale, and if our boilers are of the watertube type, carrying steam above 200 pounds, a 150-pound spring should be included.

(To be continued.)

PERFORMANCE OF THE CREOLE.

The steamship *Creole,* of the Southern Pacific Company, has been an object of interest in maritime circles for several years past, because her machinery equipment as originally built was something of a novelty, differing from the customary practice in consisting of Curtis turbines for the propelling machinery, and Babcock & Wilcox boilers fitted with superheaters for the steam generating plant.

Recently the turbines have been removed and reciprocating engines fitted. The work of installing the new machinery was carried out by the William Cramp & Sons' Ship & Engine Building Company, the new equipment consisting of two vertical, inverted direct-acting, triple expansion, surface condpensing engines with cylinders $27\frac{3}{4}$, $46\frac{1}{2}$ and 79 inches diameter by 42 inches stroke, designed for 95 revolutions per minute at a speed of 16 knots. The change from turbines to reciprocating engines was made because with the turbines the vessel was unable to make her schedule speed and proved uneconomical in coal consumption.

On May 14 and 15 the vessel was brought around from Cramps' Yard to the Southern Pacific Co.'s dock in New York, and, while no attempt was made to conduct a regular trial trip, observations of the performance of the engines and boilers were taken, with very satisfactory results. Advantage was taken of the convenient location of the measured mile at the Delaware breakwater, to standardize the screws, with the result that, without any attempt at forcing, a mean speed of over 16 knots was obtained, with a little over 7,000 horsepower. The vessel was, of course, not down to her load draft at this time, but the boilers were steaming so easily that there is no question but that the same speed can be obtained in full-load condition. It is especially to be noted, as showing the splendid workmanship on the machinery, that the vessel had not left the dock at Cramps until she went on this trip, so that the performance attained was during the first time the engines had been operated in free route.

The vessel sailed from New York May 25 in her regular passenger service between New York and New Orleans and arrived at South Pass, mouth of Mississippi river, at 7:58 P. M., May 29, 6 hours ahead of schedule. On the return trip the vessel sailed from New Orleans June 1 at 10:10 A. M. and arrived in New York at 3:00 P. M., June 5, 16 hours ahead of schedule and breaking all north-bound records between the two ports. The run south bound, bar to bar, was made in 103 hours 15 minutes, despite the fact that the vessel lost 2 hours 45 minutes between Scotland Light and Diamond Shoal on account of being operated at reduced speed in dense fog. The run, north bound, bar to bar, was made in 92 hours 20 minutes. The average speed over the bottom, bar to bar both ways, was 16.55 knots, and the vessel was fully loaded both ways, so that conditions were thoroughly normal.

When the turbines were in the ship, statements were made to the effect that the boilers could not supply sufficient steam, but on this trip, with the reciprocating engines, the fire room staff had a very easy time, and it was almost constantly necessary to check the draft to keep from raising the safety

valves. Indeed, the boiler plant is so ample that we understand the management will experiment with the use of less than the full number of boilers. The vessel's boiler equipment is the same as originally installed, i. e., 10 Babcock & Wilcox large tube type marine boilers carrying a working pressure of 210 pounds above atmosphere with 50 degrees Fahrenheit superheat. On her first trip the vessel was operated with the usual complement of men in the engine department taken from the line's regular service.

Altogether this history of the Creole is most interesting, and we hope that when there has been time for the crew to become thoroughly accustomed to the machinery, the management may see their way clear to make some careful tests with a view to determine the economy.

As far as the experience on this ship goes, it certainly tends to prove that a 16-knot vessel is not a proper place for the application of the direct-connected turbine. Indeed, we believe that Mr. Parsons is on record as not advising the use of turbines for lower speeds than about 18 knots.

The completion of the government collier, which is to be fitted with turbines operating through the Melville & Macalpine reduction gear, will be awaited with great interest, because the claim is made for this combination that both turbine and propeller will be used under conditions of maximum economy, and the gear itself on its shop tests has shown such a high efficiency that this combination ought to give an extremely economical result.

THE UNITED STATES NAVAL SCHOOL OF MARINE ENGINEERING.

Readers of International Marine Engineering will feel much personal pride in the recent establishment of a post-graduate school of marine engineering at the U. S. Naval Academy, Annapolis, Md. To the true friends of the navy who occupy positions of responsibility in civil life is due in great measure the success of the plan adopted in 1899 for amalgamating the engineer and line officers in the navy. This post-graduate school of marine engineering is the concrete development of that plan.

Since 1899 the Naval Academy has been developing along engineering lines until the Secretary of the Navy states that it is now one of the best technical schools in the country, and that its graduates are fitted to undertake subordinate engineering duties of all sorts, but he adds that their general education, even with the practical experience gained after graduation has not qualified officers for the important work of designing the machinery of our naval vessels. Since the passage of the Personnel law, in 1899, a measure which was actively urged to passage by International Marine Engineering, line officers and engineer officers of the navy have been fused into a co-ordinating unit, until now it is scarcely possible to find any officer of much length of service that has not had a considerable amount of both sorts of duty. As the Secretary states, naval officers in their manifold duties, whether in the engine room, in turrets, at the guns, whether handling electricity or training men, are constantly in charge of the operation of complicated machinery, and it may be said that they have continuous engineering duties.

The school of marine engineering was established with two primary objects in view:

First.—To stimulate general interest in engineering matters throughout the navy.

Second.—To provide competent designing engineers for the future.

The students of the school are limited in number to 20, 10 being selected each year from applicants for that duty from the line officers of the service below the rank of lieutenant-commander. The basis of selection, as announced by the department, is engineering ability, combined with evinced knowledge and ambition. The students are chosen solely according to their records of service and performance, and are a representative group of officers. In short, the school is a post-graduate honor course for officers who have served at sea for at least three years, and who have distinguished themselves among their fellows by superior engineering ability and qualifications. It is understood that the ten students selected for the first class now at the school were chosen from about 200 applicants for this duty among the younger officers of the line of the navy. Evidently where there is a general desire to improve in engineering knowledge the establishment of this school, by holding out a reward to the younger officers of the navy, will serve to accomplish its first object, namely, the stimulation of general interest in engineering matters throughout the navy.

Our readers will be particularly interested in the unique method of instruction that has been adopted at the school and in the exceptional conditions that have rendered the methods used applicable to naval conditions.

In the first place, the curriculum is peculiar. There are no professors or instructors at the school. One officer, Lieutenant-Commander Milton E. Reed, an experienced engineer, is detailed to the school as its technical head. There is in the school a considerable library of engineering books, and these have been carefully card-indexed under the various headings. A large number of engineering periodicals are regularly received at the school, and these also are indexed, in order that the latest information on engineering subjects may be readily at hand for reference.

In view of the methods by which the student officers of this school are chosen, little attempt is made to impose upon them a fixed curriculum, the head of the school acting more as a guide to the students than an instructor. The students are required to familiarize themselves with the fundamental principles and underlying ideas of everything in engineering that is requisite to a complete knowledge of marine engineering design.

For example, certain specified courses of reading are furnished the student officers concerning mechanical engineering, electrical engineering, ordnance engineering, hydraulic engineering, naval architecture, chemistry, works management, etc. This course has been so elected and extended as to require normally about four hours of reading each day by each officer.

Facilities are given at the Naval Academy to the students of the School of Marine Engineering for original experimental engineering investigation in three large engineering laboratories; the marine engineering laboratory of the Naval Academy, in which most of the mechanical appliances used in any way in the navy are exhibited, and in which these appliances may be tested; the electric laboratory of the Naval Academy, in which samples of all electrical apparatus used in the navy are set up, and in which they are tested, and the naval experiment station, likewise at Annapolis, in which experiments are regularly conducted on a large scale to determine questions of imminent interest to naval engineers.

It is not expected nor intended by the Navy Department, in the preparation of the curriculum for the school, that the foregoing work shall completely cover the post-graduate education to be given the student officers. Ample opportunity is given to them to develop ideas or methods that they may originate or elaborate leading to better efficiency, design, economy, maintenance or operation.

In addition to the foregoing a valuable feature of the course of instruction has been a series of lectures given by some of the most eminent experts in the country. These

gentlemen have appeared before the school and have delivered lectures upon the special engineering subjects with which they were most familiar, and in which they had achieved success. They have, in every case, been invited to criticise freely naval practices, and have been requested to dvelop, so far as possible, any weakness of naval engineering. In this way the student officers have come in personal contact with some of the leaders in the engineering profession. In many instances they have established friendships that will continue throughout the years, enabling them to acquire successful commercial methods and infuse them into naval designs and practices.

The most valuable educational feature of the course of instruction is provided by arranging that the student officers shall make a summer tour among the representative productive establishments of the country. For the purpose of these visits, representatives among the corporations in the Middle West and Eastern States have voluntarily tendered the freedom of their shops and plants, and ample evidence is shown that the navy and engineering in the navy is not lacking of real friends, and that commercialism does not overrule patriotism. In some of these plants special courses of lectures to the student officers at the works have been arranged by the managers. Such observations and study of commercial work and management as these visits will afford will present many comparisons which the student officer will be able to build into his future work to place ships and naval stations on an efficient and economical basis.

In addition to the work done at the school each student officer is required to submit annually to the head of the school a thesis on some engineering subject, the subject to be of his own selection and to be treated according to his own views.

The course of advanced instruction at the school of marine engineering is of two years' duration. Of this course twelve months are to be spent at the Naval Academy, eight months on visits to the commercial establishments, and four months in the study of practical designing at the Navy Department. At the completion of this course it is contemplated, in the order establishing the school, that the graduate officers will be assigned for a short time to shore duty, either in the inspection of material, in the inspection of construction of machinery, or in the actual work of repairing and overhauling naval vessels. At the end of this short period these officers will be assigned in their turn to engineering duty at sea.

In this capacity it is evident that they will disseminate throughout the service by their contact with their ship-mates, assistants and subordinates much of the general engineering knowledge that they have obtained.

From the graduates of the school it is contemplated that two officers shall be selected annually for duty as designing engineers. Normally these selections will not be made until the officers have performed two years of duty after their graduation from the School of Marine Engineering, and not until they have definitely fixed their purpose to develop themselves along engineering lines and clearly demonstrated their exceptional ability as naval engineers.

The number of these officers reserved for designing engineering duty is limited by the order of the Navy Department to twenty.

It is a pleasure to see in the plan underlying the foundation of the School of Marine Engineering, prospects for the continuation of the upbuilding of marine engineering in the navy, and for the creditable continuation of the records of such naval engineers as Haswell, Isherwood, Melville and others who have marked their time with bold strokes of progress and resourcefulness.

The method of post-graduate instruction outlined here might not be generally successful, but it seems to have been adopted with special reference to the mode of selection and the assured individuality of the students at the school. The advanced education being a reward of merit, restrictions of the field of education are not needed and are not made. The engineering world will watch this school with interest, and if the system is successful a similar one is evidently a good means of increasing efficiency in our large engineering institutions.

Launch of an Australian Destroyer.

Coincident with the launching of the battleship *Colossus*, by the Scott's Shipbuilding & Engineering Company, Greenock, Messrs. William Denny & Bros., Dumbarton, launched the Australian torpedo boat destroyer *Yarra*. This is one of three destroyers, contracts for which were placed in England by the Commonwealth of Australia in April, 1909.

These boats are all named after Australian rivers. They are of the first British "River" class, with improvements in arrangement and in machinery. This type was developed from the 30-knot vessels, whose speed was obtained under abnormal conditions.

The destroyer committee appointed by the Admiralty found that the 30-knot class were strong enough for seagoing work, but that the real speed limit in a seaway was not reached in strength, but in the amount of driving which the vessel could stand. In the new "River" class a forecastle was adopted and in all the later destroyers. The "River" class are strong, able, sea-keeping vessels. The Australian government adopted this type for their destroyers, everything being done to avoid structural breakdown of the most unimportant kind.

The *Yarra* has watertube boilers and reciprocating engines, and will obtain a speed of 25½ knots with a full seagoing load. Her dimensions are: Length, 245½ feet; breadth, 24 feet 3 inches; displacement, 700 tons. She is fitted with turbine machinery, and steam is raised by oil fuel. Her Admiralty conditions are 26 knots, but for a larger field of operations the radius of action has been increased above that of the British type, and she will carry enough oil to steam 2,500 nautical miles.

The armament consists of one 4-inch, three 12-pounders and three 18-inch torpedo tubes. The crew numbers sixty-six.

She is built of high tensile steel, and follows the practice of the British Admiralty in all structural details of hull for the "River" class of vessel. In the officers' and crew's quarters there has been a new arrangement following that recently made in the battleships. The officers are forward, immediately under the chart-house and bridge on the forecastle, while the crew are partly underneath the officers' accommodation and partly aft.

Publications Issued by the Steamboat Inspection Serice.

As a part of the valuable service rendered to the marine interests of America by the Steamboat Inspection Service, the following publications can be had by any of our readers upon application to the Supervising Inspector General of the Steamboat Inspection Service, Department of Commerce and Labor, Washington, D. C.: "General Rules and Regulations Prescribed by the Board of Supervising Inspectors"; "List of Licensed Officers of Merchant, Steam, Motor and Sail Vessels"; "Laws Governing the Steamboat Inspection Service"; "Pilot Rules for the Great Lakes and Their Connecting and Tributary Waters"; "Pilot Rules for the Rivers whose Waters Flow into the Gulf of Mexico and the Red River of the North"; "Annual Report of the Supervising Inspector General, Steamboat Inspection Service"; "Pilot Rules for the Atlantic and Pacific Coasts and Gulf of Mexico."

THE LATEST TURBINE DESTROYERS OF THE FRENCH NAVY.

Up to the last few years the French Navy has remained far behind the leading naval powers in the use of turbines, whereas in former times France has taken the lead in certain lines of naval progress, such as in submarine navigation. In 1906, however, the French Admiralty decided to follow the trend of progress, and turbine engines were ordered for the six battleships of the *Danton* class (18,000 tons). The experience of other naval powers, added to the very favorable reports of the French naval experts upon their return from a visit to the famous English *Dreadnought,* decided the Admiralty to accept Parsons' turbines. At that time the Admiralty could not have made a better choice, as the adoption of this type of machinery for the largest vessels was well known all over the world, but later on, following the example of the United States and Germany, the French Admiralty decided to carry out new experiemnts on smaller boats, such as destroyers, which are well suited for experimental purposes.

The destroyers then in service (1906) did not answer the needs of a modern fleet, as they were really too small to contend with the 800 and 900-ton destroyers of the neighboring nations. Therefore, the leading shipbuilders in France were asked to submit their best proposals for a number of destroyers, to be immediately constructed according to the following general specifications:

Armament.—Six 2.56-inch quick-firing guns, three to fire ahead and three astern. Ammunition, 2,100 shells.

Torpedo Tubes.—Three 18-inch, one in the stem. Ammunition, six torpedoes.

Machinery.—Four watertube boilers in two watertight compartments. Main engines located in separate watertight compartments.

Speed.—Twenty-eight knots for one hour, 24 knots for the four following hours.

Steaming Radius.—1,170 miles at 14 knots. Sufficient fuel for this distance to be carried on the full-power trials.

Steering Radius.—400 yards maximum.

It was also required that the boats should be capable of stopping within a distance of 250 yards when steaming at 20 knots. Wireless apparatus and a special room for its auxiliaries was to be fitted.

The plans for six different types of vessels, according to the foregoing specifications, were accepted, and each of the designer's firms received an order for one or more boats.

These destroyers are to be divided into two classes: First, those driven by reciprocating engines; second, those driven either by turbines or by reciprocating engines combined with turbines.

FIG. 2.—STERN OF THE VOLTIGEUR.

So far the *Carabinier* is the only boat of the first class which has given good results on official trials. She was built by the well-known firm Chantiers & Ateliers de St. Nazaire, at their Rouen yard. The other boats have not yet been accepted, and will have their machinery altered, according to orders just received by the Admiralty. The forced lubrica-

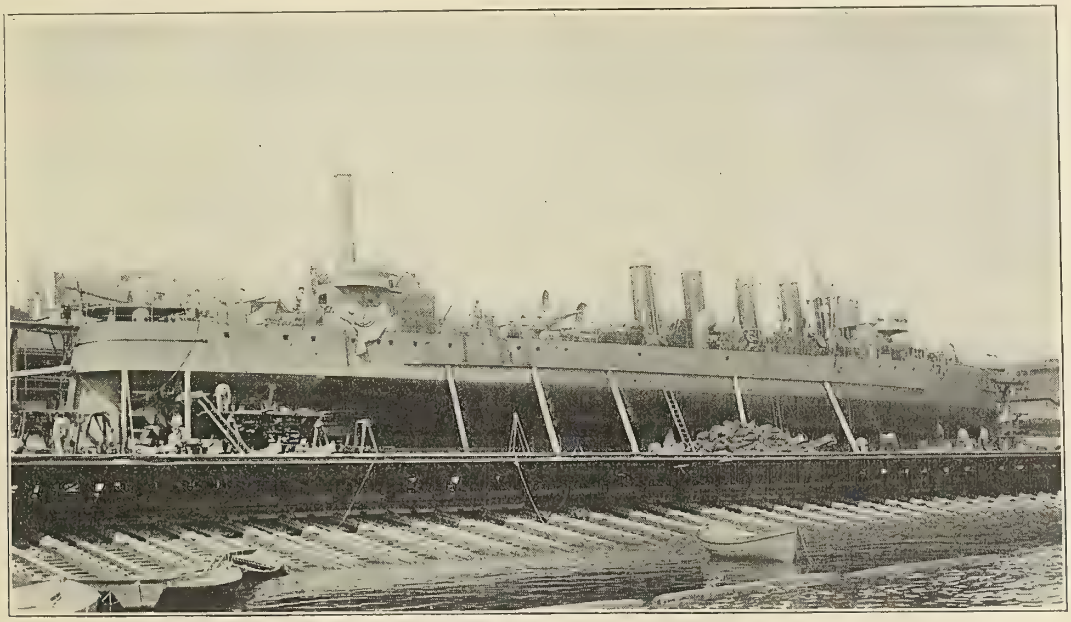


FIG. 1.—DESTROYER VOLTIGEUR ON THE WAYS.

tion system is to be completely removed, and ordinary apparatus fitted.

The second class is the most interesting. It is composed of the following destroyers: *Chasseur,* built by A. Normand & Company, Havre, Parsons turbines built by Compagnie Electro-Mecanique; *Voltigeur,* built by Ateliers & Chantiers de Bretagne (formerly de la Brosse & Fouché), Nantes, equipped with reciprocating engines and Rateau turbines; *Tirailleur,* built by Chantiers & Ateliers, de la Gironde, Bordeaux, equipped with reciprocating engines and Breguet turbines; *S. T.,* built by Schneider & Company, Le Creusot, equipped with Schneider-Zoelly turbines.

The main particulars of these destroyers are given in the appended table.

CHASSEUR.

The theory and details of construction of the Parsons marine turbine are too well known to need any description at this time. On this destroyer four main turbines are used for going ahead, three for full speed and one for cruising. Steam at full boiler pressure is admitted directly into the high-pressure turbine, driving the central shaft. Then the steam is expanded into two low-pressure turbines at the wings, whence it goes to the condenser. The turbines for this vessel have been designed to develop 7,200 horsepower at 850 revolutions per minute, giving the boat a speed of 28 knots.

At normal speed, steam is admitted directly into the high-pressure turbine, but, if necessary, the power may be increased by the opening of a by-pass valve, which admits steam under full pressure into the second stage of the turbine.

Steam from the main steam pipe is admitted to the cruising turbine which drives the starboard propeller, mounted on a hollow shaft, which extends through the starboard shaft and operates without friction. Suitable means of connection are produced between the two shafts, and a small clearance is allowed in order to allow for expansion, due to heat. For slow speed, the cruising turbine is coupled up and steam admitted to it; thus the starboard propeller runs ahead. Steam is exhausted from the cruising turbine to the central high-pressure turbine, and from there passes to the two low-pressure turbines, and is finally exhausted to the condensers. The power of the starboard low-pressure turbine is thus added to that of the cruising turbine, so that from 8 to 16 knots' speed can be easily obtained by this combination and 18 knots' speed may be obtained by opening the by-pass valve, which admits full steam pressure into the second stage of the cruising turbine.

The astern turbines are mounted on the wing shafts only, and they are incorporated in the same casings with the low-pressure ahead turbines. Maneuvering is accomplished by the use of the wing propellers, the central turbine remaining idle.

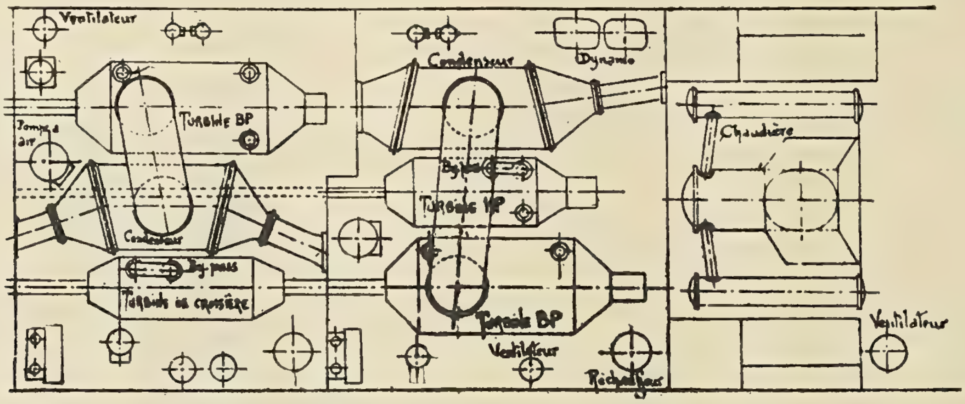


FIG. 3.—ARRANGEMENT OF TURBINES ON THE CHASSEUR.

VOLTIGEUR.

The *Voltigeur* is the first vessel equipped with Rateau turbines, and, therefore, its success is of particular interest. The Rateau turbine as improved by the Ateliers & Chantiers de Bretagne is now called the Rateau-Chantiers de Bretagne marine turbine. It is of the axial multiple stage type, combining the features of the impulse and reaction turbines. The advantages claimed for this type are that the lateral pressure on the wheels or moving disks is eliminated and the moving parts can be given considerable play in a radial direction, thus allowing easy fitting and regulation. The clearance between the shaft and the diaphragm alone is important, consequently it is reduced to .04 inch, which can readily be done owing to the small diameter of the shaft. In the latest type of Rateau-Chantiers de Bretagne marine turbine, now building for the destroyer *Fourche* and *Faux,* inside leakages of steam are completely stopped.

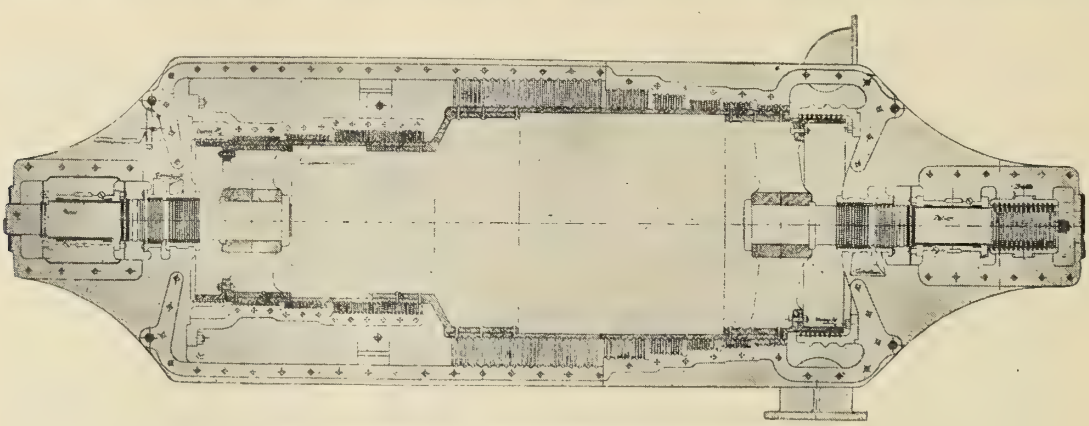


FIG. 4.—SECTION OF PARSONS TURBINE FOR THE CHASSEUR.

The diaphragms are fitted tightly in the stator, or casing, and packing is fitted around the shaft, a matter of considerable advantage in the high-pressure turbine, where the difference in pressure is more important.

The ahead and astern turbines are mounted on the same shaft and located in the same casing. Each of them may be divided into two different parts—the high-pressure and the low-pressure. The high-pressure part is built on the multiple disk principle, and has been calculated for economical running through its length into a series of separate compartments by diaphragms in order to facilitate the construction. It is also divided horizontally into two parts in order to allow the rotor to be laid aside. When fitted together, however, the casing is perfectly tight. The necessary ports for the admission and exhaust of steam, as well as for the relief valves, etc., are cast in the casing.

The diaphragms, dividing the stator, are all of cast steel, each in two pieces and fitted in grooves, made in the casing.

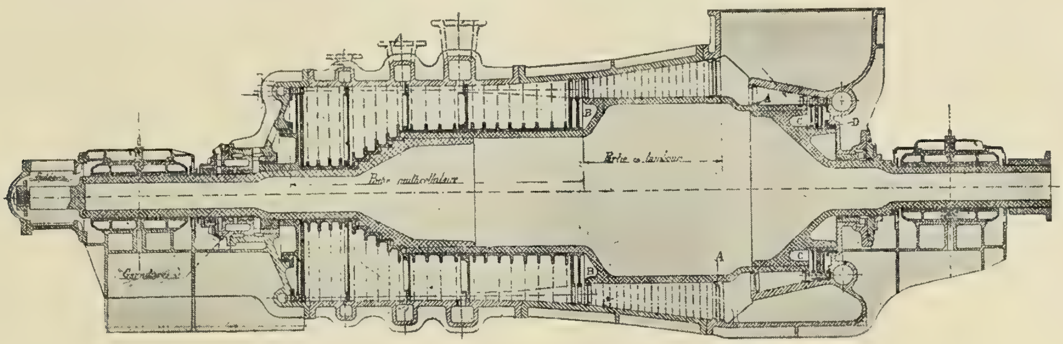


FIG. 5.—SECTION OF RATEAU TURBINE FOR THE FOURCHE.

whatever variation may be required in speed and power. The low-pressure part is mounted on a drum which gives equilibrium and counterbalances the thrust of the propeller. The pressure in each stage being low and the clearance very small, if compared with the large section of the passage in the nozzles, there is little need of guarding against steam leakage in the stationary vanes.

Steam is admitted to the turbine at several points, each of which corresponds to a different speed. The smallest power gives the longest expansion. The passage from slow speed to high speed is obtained through a single valve. The intermediate speeds are obtained by reducing the opening of the steam valve to throttle down the pressure. The astern turbines are built on the same principle as the ahead turbine, Around their periphery they carry the boxes containing the stationary blades.

The diameter of the shaft is not uniform throughout its length, but varies according to the weight of the rotor. At the stuffing boxes it is reduced to a minimum. Labyrinth packing is provided at the ends of the casing and any steam which leaks through is returned to the turbine through a special nozzle. Forced lubrication is used and the bearings are water-cooled.

The shaft is of hollow steel, carefully machined inside and out, in order to obtain a perfect balance as well as to facilitate the dismounting of the wheels and the centering of the wheels in the diaphragm. The moving wheels or disks are made of forged steel, machined on all sides and carefully balanced and

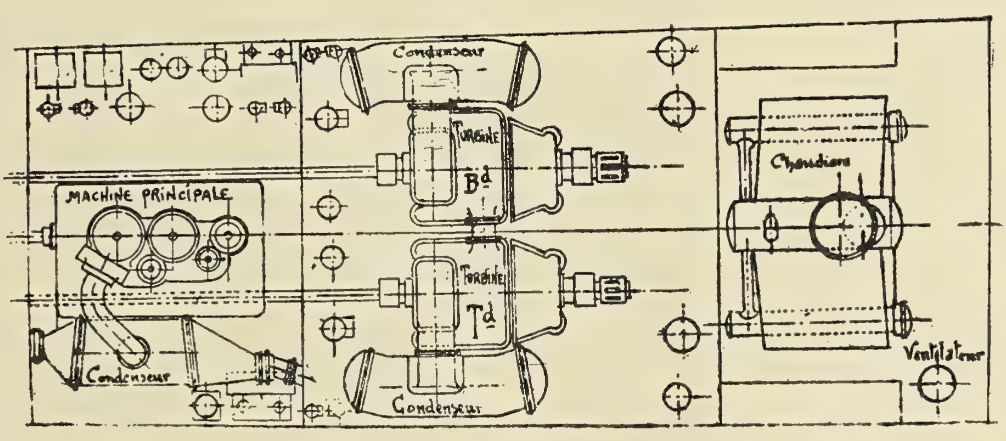


FIG. 6.—MACHINERY ARRANGEMENT OF THE VOLTIGUER.

but they are calculated to give only about 40 percent of the power of the former. As has already been stated, the thrust of the propeller when running either ahead or astern is counterbalanced by the low-pressure turbine, which has been especially designed for this purpose. A thrust block attached to the forward end of the shaft absorbs any slight differences that might occur, and at the same time assures a perfect alinement of the moving disks between the stationary blades.

There are several points of interest in connection with the construction of these turbines which are worth while noting. The stator, or casing, is cylindrical, of cast iron and is divided fastened with keys on the shaft. The blades are of special drawn brass and are erected on the drums and wheels in dovetail grooves. The correct interval is obtained by using an intermediate filling block as shown in Fig. 7. A small projection flanged at the foot of the blade extends into the filling blocks and thus gives the whole an exceptional resistance to tearing off. Two cuts are made in each wheel to give the necessary passage for the blades to enter into the groove. After the blades have been erected, they are encircled with a metallic channel-riveted ribbon to obtain regular intervals between the upper edges of the blades and to increase the

strength of the whole. Due to this construction, great solidity is obtained without welding or calking. Before the final erection of the shaft, each wheel is separately tested on a special engine at a speed equal to twice the maximum speed in service. The stationary blades are made of the same mate-

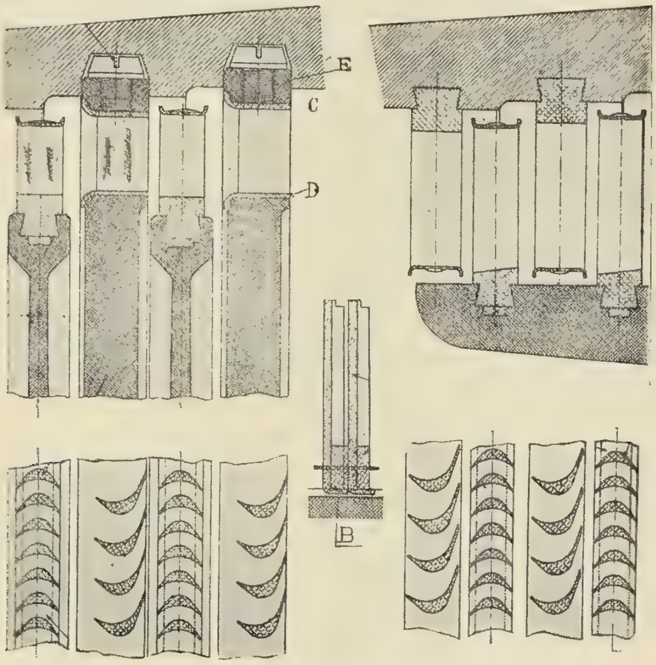


FIG. 7.—DETAILS OF CONSTRUCTION OF RATEAU TURBINE.

rial, and are erected in the diaphragms in practically the same way as the moving blades. At one end each blade carries a strip, allowing it to be fastened by means of rivets to the two brass plates, *C* and *D* (Fig. 7).

The main engines of the *Voltigeur* consist of a three-cylinder triple expansion reciprocating engine working on the center shaft and two Rateau-Chantiers de Bretagne marine turbines on the wing shafts. The main particulars of the reciprocating engine are included in the appended table. This engine exhausts either into the condenser or into the turbines according to the speed required. This engine is the first of its type designed and built by the Ateliers & Chantiers de Bretagne. It is of the inclosed type, with special forced lubrication. It is without steam jackets except on the covers.

The two turbines are located in a watertight compartment. Each turbine has been designed to develop 3,000 horsepower at 850 revolutions per minute. All movements of the engines are easily controlled from the starting platform, and it is claimed that maneuvering is as easy as with two reciprocating engines. When going ahead the propellers turn outboard.

The reciprocating engine may be used alone up to 20 knots, but there is very great advantage in exhausting steam to the turbines. By doing so the back pressure from the low-pressure cylinder of the reciprocating engine is permitted to act practically upon a piston of indefinite area, so that considerably more power can be obtained, as shown by the shaded portion in the indicator diagram shown in Fig. 8. Also, by this method the resistance of the idle propellers connected to the turbines is avoided. Such resistance is very important at 12 knots' speed and above.

TIRAILLEUR.

The turbines fitted on the dstroyer *Tirailleur* are the second set adopted by the Breguet firm to the propulsion of ships, the first one having been installed in the torpedo boat No. 294, which is now a schoolship for pilots, firemen and engineers who are specializing in torpedo boat navigation. The Breguet turbine is of the impulse type, and the difference in construction between it and the Rateau turbine consists in the fact that the blades are of the De Laval type, and calculated according to that pattern. They are made of high tensile bronze, cold drawn, and cut in length in the same direction as the metal was rolled. The fixed and moving blades are dovetailed into slots made in the annular part of the casing, or the outer part of the wheels and drums and are riveted into place. It is also worthy of note that the fixed blades have a connection at their outer ends, so that they are strongly fastened one to the other in such a maner as to form a compact block. This is of great importance because it avoids any vibration.

The machinery arrangement on the *Tirailleur* is as follows: In the compartment immediately aft the second boiler room there is a reciprocating, triple expansion engine of the inclosed type working under forced lubrication. This engine, as well as all the auxiliaries, was built by the Chantiers de St. Nazaire, and details of the engine will be found in the appended table. There are two turbines for going ahead, one high-pressure and one low-pressure, each driving a propeller. The turbines are located in separate watertight compartments.

The reciprocating engine alone is used for cruising up to 20 knots, but above that speed steam is exhausted into the turbines. The reciprocating engine is designed to develop 3,000 indicated horsepower at 350 revolutions per minute. The turbines have been designed to develop a total of 6,000 horsepower at 750 revolutions per minute when receiving steam at full boiler pressure.

There are two independent condensers, one for the reciprocating engine and one for the turbines located in the center of the turbine room. The cooling surface of the condensers is 1130 and 4360 square feet respectively.

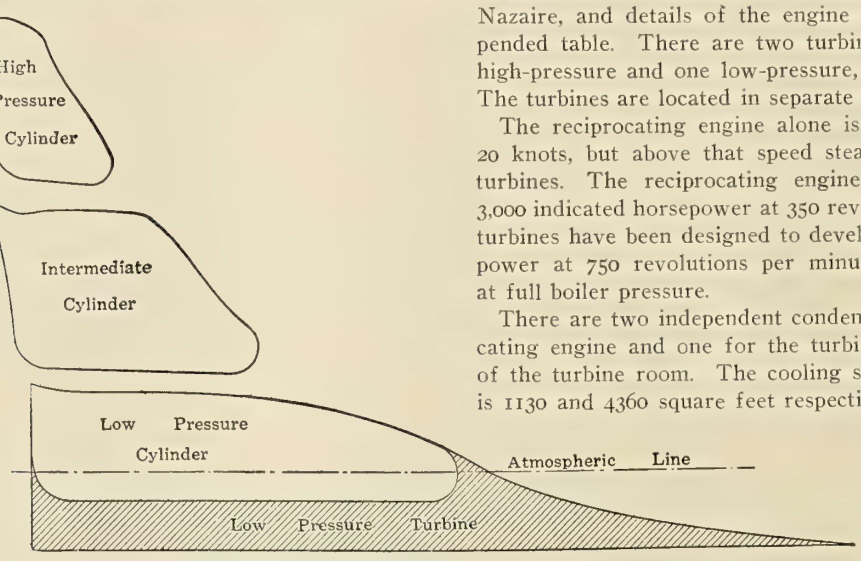


FIG. 8.—COMBINED INDICATOR DIAGRAMS OF TRIPLE EXPANSION RECIPROCATING ENGINE AND TURBINE. SHADED PORTION SHOWS WORK DONE BY TURBINE.

TRIALS.

The figures for the comparative coal consumption of these boats, as obtained on the official trial trips, are of interest. The boats driven by reciprocating engines at from 10 to 25 knots' speed show a less consumption of coal than those driven by turbines. The *Chasseur*, the only boat propelled by

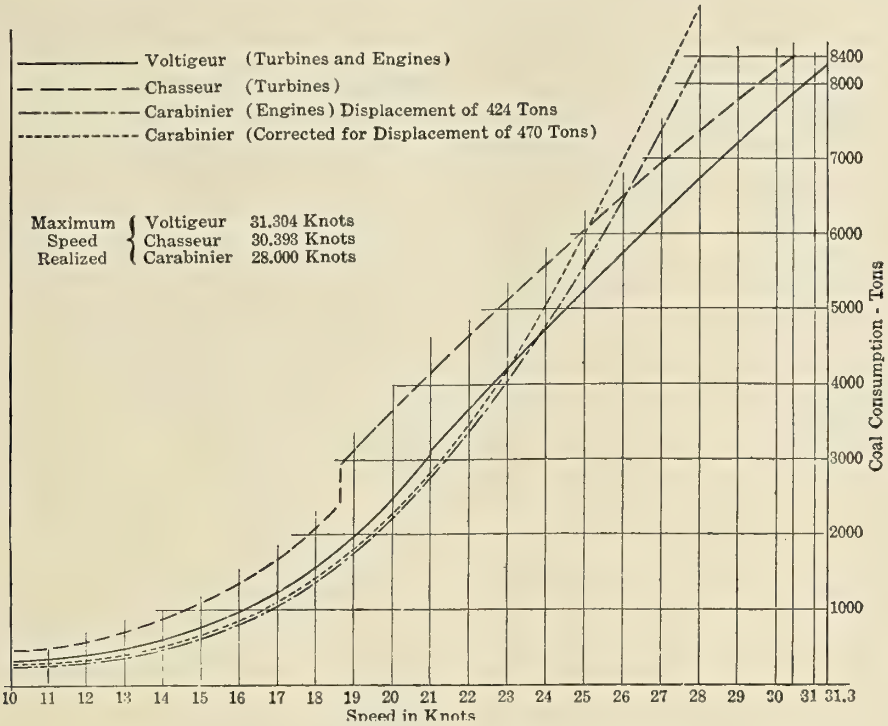


FIG. 8.—CURVES SHOWING COMPARATIVE COAL CONSUMPTION OF FRENCH DESTROYERS.

turbines alone, shows higher figures up to 25 knots, but above that point the turbines show to better advantage. The *Voltigeur* and *Tirailleur,* both fitted with combined reciprocating and turbine engines, show advantages for cruising speeds added to better figures for full power, if compared with boats of the reciprocating engine type. The *Voltigeur* gives the best results of both types. At slow speed her fuel consumption was nearly equal that of boats with reciprocating engines, and, therefore, better than that of boats driven by turbines alone. At full speed the consumption is nearly equal to that of the *Chasseur,* and even the *Voltigeur's* speed is .9 knot above that of the boat equipped with Parsons turbines. At cruising speed the *Chasseur* requires 81 tons of coal to run 1,170 miles, as against 52.87 tons required by the *Voltigeur.* The other boats, built at the same time, require respectively: Tirailleur, 57 tons; *Carabinier,* 32.33 tons; Hussard, 46.13 tons; *Spahi,* 44 tons. The saving of 28 tons if comparing the *Voltigeur* and *Chasseur* is considerable, and is accomplished by running the reciprocating engine exhausting to the turbines at low speed. At full power the advantage is caused by the economy of steam in the multi-stage expansion of the Rateau-Chantiers de Bretagne marine turbine. It is better than is readily understood at first sight, because the thrust of the propeller of the reciprocating engine is disadvantageous at high speed.

In short, it may be said that the *Voltigeur* gave the best speed coupled with the most economical fuel consumption. Several other features may also be taken into account. The hull of this destroyer has been especially designed by the well known naval architect Mons. Laubeuf, and the propellers are so placed that even in heavy weather they do not easily race. In fact, the boat is an exceptionally good sea boat and has weathered some severe storms. A good idea of the construction of the stern can be obtained from Fig. 2. The good results obtained with the *Voltigeur* are all the more remarkable when it is remembered that her hull is the first of this type, and that she is the first French naval vessel fitted with a combination of reciprocating engines and turbines, and also that many of her auxiliaries are used for the first time in France. After achieving such good results with this boat, the

TABLE I.

	Chasseur.	Voltigeur.	Tirailleur.	Carabinier.
Length over all	222′	215′ 3″	....	211′ 4″
Length B. P.	210′ 8″	....	206′ 11″	210′ 8″
Breadth, extreme	22′ 2″	22′ 10″	22′ 6″	21′
Depth	13′ 9″	14′ 4″	....	14′ 9″
Draft, astern	9′ 3″	9′ 10″	9′ 6″	9′ 4″
Displacement, tons	447	470	414	416
Boilers, type	Normand.	Normand.	Du Temple.	Du Temple.
Grate surface, square feet	232	232	230	230
Heating surface, square feet	11,100	11,100	9,900	9,900
Steam pressure, pounds per square inch	228	228	257	257
Air pressure in hold	2½ to 3 inches of water.			
Bunker capacity, tons	80	90	80	3,900 cu.ft.
Engines, type	....	3-cyl. triple.	3-cyl. triple.	4-cyl. triple.
Diameter cylinders, inches	....	17–25–38	20–29–41	20–31–34–34
Stroke, inches	....	20	23	20
R. P. M. maximum	....	380	350	333
I. H. P.	....	2,700	3,500	7,500 (5 hrs.) 8,200 (1 hr.)
Turbines, type	Parsons.	Rateau—Ch.d.B.	Breguet.	....
Ahead turbines	4	2	2	....
Astern turbines	2	2	2	....
Cruising turbines	1	....	....	....
R. P. M.	940	850	....	....
Total horsepower	7,800	6,250	5,800	....
Cons. surface, square feet	(?)	37,800	(?)	(?)
Vacuum, inches	29	29	29	29
Propellers	3	3	3	2
Diameter	4′ 7″	(?)	(?)	(?)
Armament	Six 2.56-inch quick firing guns, 2,300 shells; three 18-inch torpedo tubes, six torpedoes.			

TABLE II.—OFFICIAL TRIALS.

8-HOUR TRIAL AT 14 KNOTS SPEED.

	Chasseur.	Voltigeur.	Tirailleur.	Carabinier.
Displacement on trial	470	468	450	428
Mean speed, knots	13.872	14.09	14.08	14.02
Coal per hour, pounds	2,128	1,402	1,533	1,003
Coal per square foot grate surface per hour, pounds	18.2	12	12.5	8.73
Coal per mile at 14 knots, pounds	153.4	99.6	109.5	71.3
Coal required to cover 1,170 miles at 14 knots, tons	79.7	52	56.1	37.3

5-HOUR TRIAL AT 24 KNOTS SPEED.

Mean speed	25.58	24.74	24.42	24
Coal per hour, tons	6.34	5.03	5.58	4.73
Coal per square foot grate surface per hour, pounds	61.1	47.6	53.7	45.8
Coal per mile run, pounds	555.7	456.4	512.2	441
Coal per mile at 24 knots, pounds	511.6	436.6	435.9	441

1-HOUR FULL SPEED TRIAL.

Mean speed	30.393	31.304	28.85	27.7
Coal per hour, tons	8.35	8.15	8.43	8.26
Coal per square foot grate surface per hour, pounds	80.5	77.2	81.2	80.4
Coal per mile run, pounds	615.2	582.1	652.7	66.81
Coal per mile at 30 knots, pounds	604.2	568.9	.....	.....

builders received an order for two 750-ton destroyers for the French Admiralty of 14,000 horsepower, 32 knots speed, and an order for four destroyers for the Argentine Navy of 900 tons displacement and from 32 to 33 knots' speed.

The hulls of these boats have been built with particular care. The keel is 18 inches deep for three-quarters of the length amidships, and a quarter inch thick. The stems are of forged steel and the outboard propeller shaft bearings of cast steel. The hulls are divided into ten watertight compartments. The auxiliary machinery consists of an electric generator of 100 amperes, 80 volts; steam steering gear and hand steering gear, a steam pump with a capacity of 2,500 gallons per hour, eight ejectors with a capacity of 100-tons per hour, one 200-ton and one 1,200-ton turbine pump and an air compressor for the torpedoes. Since more powerful boats have now been ordered by the French Admiralty, there will soon be an opportunity for an interesting comparison between them and those described in this article.

THE INSTITUTION OF NAVAL ARCHITECTS *

The Institution of Naval Architects is to be heartily congratulated upon the completion of its first half century of useful service. Beginning with a membership of some 300 at the end of the year 1860, it has now reached, through a period of uniform success, a total of 1,750. It has become the central institute of a great industry scattered around the coast of the United Kingdom. On its Council are representatives of practically all districts where shipbuilding and engineering are practiced, while among its associates are to be found many shipowners and representatives of the large shipping institutions, as well as naval officers and scientific men interested in the theory of shipbuilding. It seems an appropriate occasion, when the attention of every similar society in the world is directed toward the British institution by reason of its fiftieth anniversary to give a short account of its life work and aims.

On Jan. 16, 1860, at the hall of the Society for the Encouragement of Arts, Manufactures and Commerce, Adelphi, London, at a meeting of some eighteen gentlemen, the following resolution was moved by Mr. Oliver Lang, and seconded by Mr. John White: "That we who are here present do now constitute ourselves an Institution of Naval Architects, for the purpose of advancing the science and the art of naval architecture." The names of these gentlemen who thus became the founders of the society were as follows: Nathaniel Barnaby, F. Kynaston Barnes, H. Chatfield, J. B. Chessill Crossland, J. Grantham, Oliver Lang, J. MacGregor, J. Martin, Alexander Moore, John Penn, E. J. Reed, J. H. Ritchie, W. B. Robinson, J. Scott Russell, P. Thornton, G. Turner, J. White and the Rev. Joseph Woolley. Of these only Sir Nathaniel Barnaby is alive now.

For many years the need of such an institution had been felt by those interested in the welfare of British shipbuilding. Although the greatest maritime nation upon the face of the earth, Great Britain had never up to that time been able to concentrate the knowledge which was individually possessed by her citizens into one mass, nor was there any public body to which reference could be made in the investigation of professional questions. In other sciences, such as geology and geography, the experiment of establishing an institution had been tried, and always with success, and the more recent example of the civil engineers made the success of this new undertaking seem possible, although the failure of some previous attempts weakened the confidence of many.

The period was a remarkable one in many ways. Owing to the shortsighted policy of the government there were but few trained naval architects in the country. A short while before a good deal of carrying trade had been wrested from English ships by the American clippers, owing to their handiness and speed, and British builders had been forced to recognize their superiority, and copy this class of ship to regain the trade. More recently the schooner *America* had visited England and given another hard lesson. The introduction of the power of steam had altogether altered the principles of naval arctitecture. All civilized countries were starting fair in the race of competition, and it was necessary that England should win. This was felt everywhere, with the natural result that the Royal navy was a subject of much anxiety to the public.

The beneficial influence which an institution of naval architects would exert on the most valued and cherished interest of the country could not be gainsaid, and several gentlemen began independently to consider it. At the end of 1859 Mr. John Scott Russell, who was well acquainted with the organization of the Society of Arts and the Institution of Civil Engineers, called together Mr. (now Sir Nathaniel) Barnaby, Mr. Samuda, Mr. Reed and Dr. Woolley to discuss the matter. In order to accomplish their task it was necessary to have an efficient and tactful secretary, and no better choice could have been made than Mr.—afterwards Sir Edward—Reed, who filled this position for the next three years.

Following the meeting in January, to which reference has already been made, came the inaugural meetings of the institute, which took place in the first week of March, 1860, in the hall of the Society of Arts, where, owing to the continued kindness of the society, the meetings are still held.

In view of the national interests likely to be advanced by the institution, and contrary to the general practice of technical societies, a non-professional president was chosen, and His Grace the Duke of Northumberland was asked to honor the institute by becoming its president, but owing to imperfect health he was debarred from undertaking the duties, and the Right Hon. Sir John Somerset Pakington, G. C. B., D. C. L., etc., consented to take the office. Much of the success of the institution from its inception was due to the steady adherence and unhesitating support of this its first president, who remained in office for twenty years. Indeed, the institution has been most fortunate in its presidents, among those who have presided over its deliberations being such notable men as Lord Brassey, the Earl of Glasgow and Earl Cawdor, who has held the office with distinction for the last two years.

These first meetings, on which so much rested, were most successful, and the beneficial influence of them was seen almost immediately in modifications of the Board of Custom's rule for granting tonnage allowance for propelling power and by Lloyd's modifying the application of their tables of scantlings. These points were raised and discussed during the meetings.

At first the institute consisted of only members who were professional naval architects or shipbuilders and associates; but after a few years, owing to the growing importance of engineering, marine engineers were also made eligible for membership, and still another class, termed associate members, was formed in 1899.

From the beginning it was laid down that the scope of the institution must of necessity be wide enough to embrace the consideration of all that is part of or belongs specially to a ship. In its records the objects of the society are given under three headings:

First, the bringing together of those results of experience which so many shipbuilders, naval officers and others acquire independently of each other, and which, though comparatively

* EDITOR'S NOTE:—The year 1910 marks the fiftieth anniversary of the founding of the Institution of Naval Architects. It was planned to celebrate this anniversary by holding in July an International Congress of Naval Architecture and Marine Engineering, but, on account of the death of His Majesty, King Edward VII., the jubilee meetings have been postponed and will be held next year.

valueless when unconnected, tend much to improve our navies when brought together.

Second, the carrying out of experimental inquiries of too great magnitude for private persons to undertake individually.

Third, the examination of new inventions and the investigation of those professional questions which without such an establishment would be left undecided for many years.

That the institution has carried out this programme, so far as it was humanly possible, none who studies its printed transactions can doubt. Among the early works of the society was the drawing up of a scheme for the promotion of a school of naval architecture. This was the result of a paper read before the institute by Mr. J. Scott Russell in 1863, on the education of naval architects in England and France, drawing attention to the total absence of any provision for training the rising architect in this country. Two schools of naval architecture had previously been in existence, but these had both been abolished, the first in 1833, the second in 1853, by Sir James Graham.

This paper roused considerable interest in the subject, and as a result a committee, consisting of various members of the institute, set to work and approached the Admiralty on the matter. Their proposals were met in a very liberal spirit, and in November, 1864, a school of naval architecture was started at South Kensington, with Dr. Woolley as superintendent and Mr. Merrifield principal, on the lines worked out by the institution. This school was transferred later on to the Royal Naval College, Greenwich, where it has flourished to this day. Students from every maritime country in the world have been trained in it, and almost every present member of the Royal Corps of Naval Constructors received his training here. If no other object had been attained by the institution than the establishment of this school, by this alone its existence has been justified.

In more recent times the society has displayed its concern and interest in the training of young naval architects by its successful effort to revise the syllabus set by the Board of Education in naval architecture, by the institution in 1904 of a student class of members, giving to younger men most of the privileges of full membership. Also, owing to the generosity of several members, it is now able to award a valuable scholarship every year.

Another and important work of the institute in its early years, and one of which it may be justly proud, was its long-sustained effort to secure better provision against the loss of passenger and other vessels at sea. It was in 1866 that a resolution was passed calling together a meeting of the Council for the purpose of formulating recommendations for this. At the time there was grave suspicion as to the condition in which many merchant vessels went to sea; and the succession of losses, and in particular the loss of the *London* and *Amalia,* during the previous year showed the imperative necessity of some action being taken. The Council met on many occasions, and presented a report in 1867. In this report reference was made not only to the load-waterline and minimum freeboard question, but to equipment, sub-division, etc.

The Board of Trade and Admiralty were approached, with a view to a royal commission being held, but without success. The institution, however, did not allow the matter to drop, and further representations were made on several occasions during the next few years; but it was not till 1873 that a royal commission was issued. For this we are largely indebted to the energy and ability of Mr. Plimsoll, member for Derby, whose statements brought upon him several actions for defamation. The institution was represented on this commission in the person of Mr. Merrifield. The final report of the commission, so far as it directly concerned naval architure, was of a negative character, and it was not till 1883, when the Board of Trade appointed a committee, on which the institute was represented by Dr. Elgar, that definite rules for freeboard were laid down, and not till 1890 was the assignment of a maximum load line , as determined by these tables, made compulsory by act of Parliament.

It would not be possible in the space of this article to examine in any detail the work of the institution in every direction. No important movement or change, whether in theory or practice of shipbuilding or mercantile legislation, has taken place without very full discussion at its meetings, and not a few of these movements have been brought about by the initiative of the society itself. Two examples of this during the last decade may be given.

It was the direct outcome of representations made to the Admiralty by the Council that a committee (on which the institute was represented by Professor Biles) was formed in 1902 to inquire into the question of mercantile auxiliaries. Improved designs and speed were wanted, and some steps were necessary to prevent subsidized vessels being transferred to a foreign flag.

The building of an experimental tank at Teddington, for the purpose of testing ship models and for research work, is the latest and one of the best examples of the influence of the institution. It was at Glasgow, in 1901, that a resolution was passed to consider the possibility of such a tank. Italy, Germany, Russia, Holland and the United States all had adopted Mr. Froude's method of investigation, and it was most desirable that it should be more widely applied in the country in which it originated. The question was raised by the Council on several occasions. The proposal had behind it all the notable men in naval architecture, and in particular, Sir William White, through whose persistent efforts the idea has always been kept before the country. It was owing to the munificence of Mr. A. F. Yarrow, a vice-president of the institution, that it became possible, in 1908, to proceed with the building of such a tank, the major part of the maintenance of which is assured for a considerable period by a number of the large shipbuilding firms and shipowners of the country.

To see that the institution is succeeding in carrying out its aims as regards the gathering together of the results of experience, and promoting the investigation of professional questions, one needs only to turn to the volumes of the *Proceedings.* Here are to be found the classic researches of W. and R. E. Froude, W. J. Rankine and W. Fairbairn, and valuable contributions by Scott Russell, F. K. Barnes, Sir Nathaniel Barnaby, Sir William White, Sir Philip Watts, Professor Biles and Benjamin Martell. They contain a complete record of the development of ship construction, propulsion and navigation, and of all the principal achievements in these directions, and their wealth of data makes them invaluable to the naval architect.

Originating in a gift by the late Samuel Read (a former master shipwright of Sheerness), the institute has gathered together a collection of books, which constitutes a most valuable library of reference on any point in connection with naval architecture and the allied trades.

The institution exercises a considerable influence in all mercantile affairs by means of its representatives on various public bodies, such as the advisory committee to the Board of Trade, the technical sub-committee of *Lloyd's Register,* the engineering standards committee and the National Physical Laboratory. The society is also represented on the Courts of Liverpool, Sheffield and Bristol Universities, and on the governing body of the Imperial College of Science and Technology at South Kensington.

From an international standpoint the institution has a most beneficial influence. It is essentially cosmopolitan in its composition, numbering in its ranks distinguished men from every maritime country, to whom are due some valuable contributions to its *Transactions.* The various international meetings

of such societies as this, which have been held in recent years at London, Paris, Bordeaux, Berlin, etc., serve largely to promote the mutual appreciation of the allied interest of all nations in continued progress, and a more friendly feeling than would otherwise be possible.

The desirability of placing the institution upon a more permanent footing, and the universal recognition of its valuable services to the country in the past, have led the Council and members to apply for incorporation under a Royal Charter, and we hope that at the meetings in July the Council will be able to speak of the success of their petition to His Majesty the King.

STEEL SCREW COLLIERS, COASTWISE AND TRANSPORTATION.

Two steel single-screw colliers were recently completed by the New York Shipbuilding Company, Camden, N. J., for the Coastwise Transportation Company, Boston, Mass. The vessels are intended for the coastwise coal trade between Baltimore and Boston. Both are of the following dimensions:

Length between perpendiculars.....	360 feet.
Beam molded	49 feet.
Depth molded to upper deck.......	30 feet.
Load draft	22 feet 6 inches.
Deadweight at this draft..........	6,400 tons.
Gross tonnage	4,015
Speed, loaded, at sea...............	11 knots.

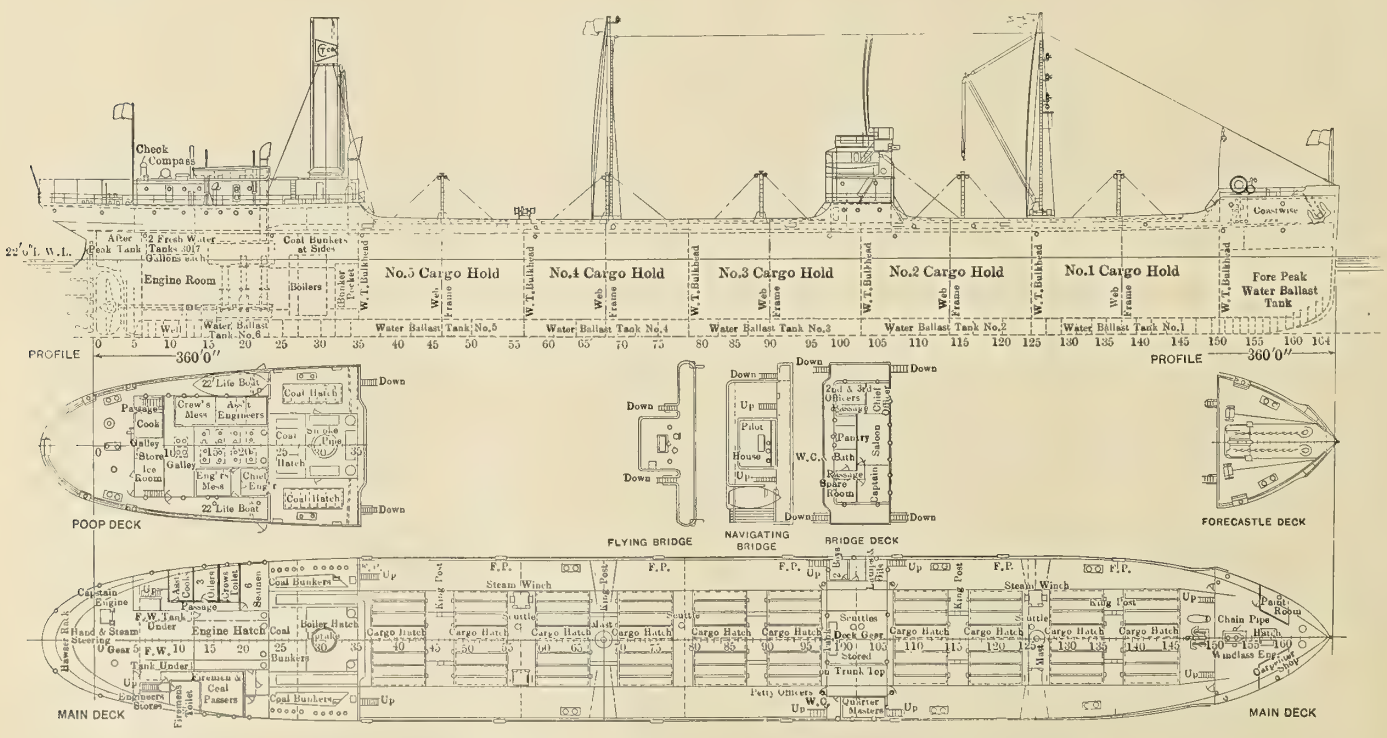
The vessels are of steel, built in accordance with the rules of the American Bureau of Shipping, single deck, with poop 76 feet, bridge 17 feet, and top gallant forecastle 34 feet long, seven steel watertight bulkheads, straight stem and semi-elliptical stern, with two pole masts. The five cargo spaces are clear of hold beams and pillars, the deck being supported by deep arched beams and web frames, midway between the bulkheads, with a deep girder, carried all fore and aft, forming a trunk 24 inches above the upper deck. Ten cargo hatches, 15 feet 2 inches long by 27 feet 6 inches wide, are arranged, closely spaced on top of the trunk to facilitate the rapid loading and discharging of the cargo. The hatch covers are steel, hinged in two pieces, watertight, and provided with special lifting gear and posts for supporting them when open. Two steam winches from which leads are taken for operating the hatch covers are placed on top of the trunk at each end of the vessel.

Accommodations, including the captain's saloon, spare stateroom, officers' quarters, etc., are provided in a large steel deckhouse on the bridge deck, with a pilothouse on top of the bridge house. Quartermasters and boys' quarters and toilet and lamp rooms are arranged at the sides in the bridge erection. The engineers are berthed in a deckhouse on the poop deck alongside the engine casing; the galley, messes, ice-room and galley stores being arranged abaft the same. Entrance to accommodations for the crew and firemen in the poop are provided in the after deckhouse, and the seamen, firemen, oilers, assistant cooks, toilets, etc., are located in the poop alongside the engine casing.

There is a steam windlass forward, the engine being located on the upper deck in the forecastle; the wild-cats and warping drums are on the forecastle immediately above. A capstan is also provided on the poop deck with its engine on the upper deck below. Steam steering gear is fitted on the upper deck in the poop abaft the engine casing, with connection to the pilot house. Auxiliary hand steering gear, with right and left-hand screw, is attached directly to the crosshead on the rudder stock. Two metallic lifeboats are provided and fitted under Mallory davits on the poop deckhouse, a wooden working boat being also provided on the bridge deck. Vessels are well provided with all the necessary bitts, cleats, etc., for mooring purposes, and a special towing bitt and chock is fitted aft.

An extra deep double bottom is fitted for the carriage of water ballast, with feed water under the boilers. The fore and after peaks are arranged for water ballast. Coal bunkers are arranged beside the boilers and in the 'tween decks alongside the boiler casing, with pockets to the fire-room.

The propelling machinery is placed aft, and consists of two



GENERAL ARRANGEMENT OF NEW COLLIERS BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

single-ended Scotch boilers, 17 feet diameter by 11 feet 4 inches long, with a working pressure of 175 pounds; triple-expansion engines of 1,700 indicated horsepower, with cylinders 24¼, 38½ and 64 inches diameter by 45 inches stroke, with a surface condenser attached. The propeller is 16 feet diameter.

The trial trips were run on the Delaware River course at Deep Water Point in fully ballasted condition, during which a mean speed of 13 knots was obtained, with somewhat more than the normal horsepower mentioned above. In loaded condition the vessels have maintained an average speed between Baltimore and Boston of slightly in excess of 11 knots, carrying a full coal cargo.

NEW SINGLE-SCREW 4,000-TON COLLIER FOR THE COASTWISE TRANSPORTATION COMPANY.

TRIAL TRIP OF S. S. TAMELE.

On Saturday, April 30, 1910, the new steamer *Tamele* proceeded on her official trial trip after adjusting compasses in Hartlepool Bay. The vessel has been built by Messrs. Irvine's Shipbuilding & Dry Docks Co., Ltd., Middleton Shipyard, Hartlepool, and is the sixth vessel built by them for Messrs. Elder, Dempster & Co., Liverpool, and one of three passenger and cargo vessels under construction at the Middleton Shipyard for the same owners.

The *Tamele* has very fine lines, and has been specially designed with main, upper and shelter decks. The vessel is otherwise strengthened to suit the owners' West African trade. The dimensions are: Length, 375 feet; beam extreme, 50 feet; depth molded, 25 feet 3 inches to upper deck, with all the 'tween decks and houses 8 feet in height. She is classed 100 A1 at Lloyds, and has cellular double bottom all fore and aft, with fore and after peaks for water ballast. The vessel is divided into seven watertight compartments by six transverse bulkheads, and every attention has been paid to all appliances for the rapid loading and discharging of cargo, the ship having nine powerful steam winches of the builders' own design, and ten derricks capable of lifting 5 tons each; provision is made on each mast for a special derrick dealing with 30 ton loads, while the whole of the mast arrangement is strengthened to lift 40 tons.

Accommodations for 30 first class passengers in two-berth stateroms is arranged under the bridge, with ladies' cabins, lavatories, baths, etc., and second class passengers at the after end of the poop. The dining room is on top of the bridge, and the smoking room and accommodation for the captain and officers is on the promenade deck above, which etxends the whole length of the bridge; the engineers and other officers' accommodation is arranged in steel houses under the bridge deck at the after end. The vessel has steel decks sheathed with wood on the poop, bridge, forecastle and promenade decks, and the whole of the passenger accommodation and public rooms are bright and cheerful, being lighted by large sidelights, and are specially ventilated in view of the tropical climate in which the vessel will be engaged.

Under the second class accommodation aft, provision is made for large icehouses, mail rooms, specie rooms, paint rooms, lamp rooms and general store rooms, and spacious accommodation for the seamen, firemen and petty officers is arranged under the forecastle, with separate mess rooms and wash places for the crew and firemen.

The vessel is fitted with the usual complement of lifeboats, together with six surf boats of special design for carrying palm oil through the surf. A complete installation of electric light is fitted by Messrs. Campbell & Isherwood, Liverpool, including signal lamps, binnacle lamps, cargo clusters at each hatch, as well as oil lamps for emergency purposes. Steam steering gear is fitted amidships and a quick warping steam windlass forward, steam being supplied to all deck machinery from either of the main boilers.

The triple expansion engines, by Messrs. Richardsons, Westgarth & Co., Ltd., Hartlepool, are of special interest, because of the installation of the "Contraflo" system of steam condensation and feed water temperature regulation. The sizes of the cylinders are as follows: H. P. 25 inches, I. P. 40 inches and L. P. 68 inches by 48-inch stroke, supplied with steam from three main boilers working at 180 pounds pressure. A leading feature of the design which will appeal to those responsible for the economical running and maintenance of a marine engine is that the ordinary simple air pump is retained, but by an ingenious method of temperature regulation its air-withdrawing capacity can be so adjusted to meet requirements and so dominate the air leakage into the condenser that the thermal efficiency of the system is at a maximum under all conditions of working, thereby very favorably influencing the consumption of coal.

This system was fitted some time ago on Messrs. Elder, Dempster & Co.'s steamship *Bassam,* also built by Messrs. Irvine's Shipbuilding & Dry Docks Co., Ltd., and after a voyage to the west coast of Africa the results obtained were so strikingly satisfactory that the system was applied to the

steamship *Tamele* and will also be fitted to the other two boats yet to be delivered.

It was found in the steamship *Bassam* that a vacuum of 27 inches could easily be carried in the tropics, with the obvious advantage that the speed of the ship was maintained, whereas with the ordinary type of marine condenser, tropical water produces a considerable fall in vacuum and as a consequence the speed suffers.

The new design of Cascade Oil Filter fitted in the engine room also proved very successful in separating the float oil from the feed water before passing to the boilers. This filter also acts as a feed water heater, and steam from the evaporator, drainage water from the coils and also from the I. P. casing is led into the filter, with the object of utilizing the heat in the steam, and in the drainage water for raising the feed water to the highest temperature consistent with the effective working of the feed pumps, the degree of temperature being very conveniently controlled by the feed temperature regulating valve fitted on the condenser.

The power developed on the trial was 2470 I. H. P. at 86 R. P. M., and the results obtained were in every way satisfactory, a mean speed of 12¼ knots being obtained on the Whitley mile. The extreme flexibility of the Contraflo system was well illustrated, as a vacuum of 29 inches was obtained with a 30.2 inch barometer, a result which is remarkable for engines of the reciprocating type.

NEW AMERICAN BATTLESHIPS.

The contracts for the first two American battleships of the *Dreadnought* type were signed Aug. 6, 1907 These contracts were awarded to the Fore River Shipbuilding Company, of Quincy, Mass., for the construction of the *North Dakota*, and to the Newport News Shipbuilding & Dry Dock Company, of Newport News, Va., for the *Delaware*. The contract price of the former ship was $4,377,000 (£891,000), and of the latter, $3,987,000 (£820,000), which does not include armor and armor bolts (exclusive of protective deck), ordnance and ordnance outfit, and certain articles supplied by the government. The contract time for the completion of the *North Dakota* was thirty-four and one-half months, and for the *Delaware* thirty-six months. The fire rooms and boilers are fitted for both coal and oil fuel, and the closed fire room system is used. The two foregoing ships are now completed and ready to go into commission.

The *Delaware* was standardized over the measured mile course off Rockland, Me., Oct. 22 and 23, 1909, and attained a maximum speed on the full-power trial of 21.56 knots on a total of 28,578 indicated horsepower for the main engines on 128.38 mean revolutions per minute, 1.888 pounds coal per indicated horsepower of main engines, and a water consumption of 13.38 pounds per indicated horsepower of main engines only.

The *North Dakota* was standardized on the same measured mile course Nov. 4, 1909, and attained a maximum speed on the four-hour full-power trial, with slightly increased displacement, 20,051 tons, of 21.64 knots on a total of 31,826 shaft horsepower, at mean revolutions of both turbines of 280.8 per minute, 1.71 pounds of coal per shaft horsepower of main turbines, and a water consumption of 13.18 pounds per shaft horsepower of main turbines only.

The next two ships, the *Florida* and *Utah*, now under construction, the former at the Brooklyn Navy Yard, New York, and the latter at the New York Shipbuilding Company, Camden, N. J., are about 70 percent completed. The contract for the *Utah* was signed Nov. 24, 1908, at a price of $3,946,000 (£815,000), the time of completion being thirty-two months, the contract calling for a speed of 20¾ knots for four hours. The *Utah* was launched Dec. 23, 1909, and the *Florida* May 12, 1910.

The contract for the construction of the *Arkansas* was awarded Sept. 25, 1909, to the New York Shipbuilding Company, at a price of $4,675,000 (£961,000), time of completion thirty-two months; the contract speed being 20½ knots for four hours.

The construction of the *Wyoming* was awarded the William Cramp & Sons Ship & Engine Building Company, of Philadelphia, Pa., Oct. 14, 1909, at a total cost of $4,450,000 (£915,000), to be completed within thirty-two months. The contract speed is the same as for the *Arkansas*, or 20½ knots for four hours.

The present naval appropriation bill includes, among other vessels, two battleships, designated No. 34 and No. 35. The plans for these ships are nearly completed and have, as far as completed, received the approval of the Secretary of the Navy. The machinery of these vessels will be steam turbines of either the Parsons or the Curtis type, and, if of the former, will have four shafts; if of the latter type, two shafts. They will have watertube boilers of an approved design, and the speed will be 21 knots. The principal feature of these two ships will rest in the main battery, which will consist of ten 14-inch 45-caliber guns. The displacement will be about 27,000 tons, and the horsepower about 32,000, and the cost of construction probably in the neighborhood of $11,000,000 (£2,260,000). Principal dimensions and data will be found in the table appended.

PRINCIPAL FEATURES OF THE LATEST AMERICAN BATTLESHIPS

Hull, machinery and armament (1)	Delaware.	Florida.	Wyoming.	No. 34.
(2)	North Dakota.	Utah.	Arkansas.	No. 35.
Builder's name and place (1)	N. P. N. Sh. B. & D. Co., Newport News, Va.	N. Y. Navy Yard, New York.	Wm. Cramp & Son, Philadelphia.	......
(2)	Fore River Sh. B. Co., Quincy, Mass.	N. Y. Sh. B. Co., Camden, N. J.	N. Y. Sh. B. Co., Camden, N. J.	......
Length over all (1)	518′ 9″	......	......	......
(2)	518′ 11¼″	521′ 6″	554′ 0″ on load waterline.	......
Beam, extreme	85′ 2½″	88′ 2½″	93′ 2⅝″	......
Draft (mean)	26′ 10¼″	28′ 6″	28′ 6″	......
Displacement, normal tons	20,000	21,825	26,000	27,000
Coal supply, tons	2,500	2,500	2,500	......
Oil supply, tons	400	400	400	......
Main battery	45 caliber, 10—12-inch.	45 caliber, 10—12-inch.	50 caliber, 12—12-inch.	45 caliber, 10—14-inch.
Secondary battery	14—5-inch.	16—5-inch.	21—5-inch.	......
Belt armor	12″ to 8″	12″ to 8″	11″ to 9″	......
Speed (contract), knots	21	20.75	20.5	21
Main propelling engines (1)	4-cyl. triple expansion.	Parsons.	Parsons.	......
(2)	144″ Curtis turbines.	Turbines.	Turbines.	......
Number of shafts	Two.	Four.	Four.	......
Revolutions per minute (1)	125	330	330	......
(2)	245	......	......	......
I.H.P. or S.H.P. (designed)	25,000	28,000	28,000	32,000
Steam pressure at engine (gage)	265 lbs.	175 lbs.	175 lbs.	......
Working pressure at boilers (gage)	295 lbs.	200 lbs.	210 lbs.	......
Diameter of propellers (1)	19′ 9″	9′ 2″	9′ 2″	......
(2)	13′ 0″	......	......	......
Condensing surface in square feet (1)	23,576	30,500	Alberger.	......
(2)	29,366	......	28,000, Weir.	......
Type of boilers	B. & W.	B. & W.	B. & W.	......
Number boilers	14	12	12	......
Number firerooms	1 single, 3 double.	3 double.	3 double.	......
Length firerooms, total	128′ 0″	102′ 0″	102′ 0″	......
Length engine room, total	44′ 0″	60′ 0″	60′ 0″	......
Superheat	50 degrees F.	None.	None.	......
Grate surface, total, square feet	1,439	1,428	1,428	......
Heating surface, total, square feet	61,943	64,234	64,234	......
Length of grate in feet	7	7	7	......

In a paper presented to the American Society for Testing Materials, the following simple test to ascertain the value of lubricating oils under service conditions was described: The test consists of heating the oils to a temperature of 450 degrees F., at which temperature oils of an inferior nature show a decided darkening of color, while good oils appear to undergo very little change in color.

PASSENGER AND FREIGHT STEAMSHIPS CITY OF MONTGOMERY AND CITY OF ST. LOUIS.

The month of June witnessed the entrance into the New York-Savannah service of the Ocean Steamship Company, popularly known as the "Savannah Line," of the two latest additions to their fleet, which are also the most recent of the many passenger and freight steamships sailing from New York in the coastwise service. The vessels in question are the *City of Montgomery* and the *City of St. Louis*, the former named in honor of the capitol of Alabama and the latter in honor of the metropolis of Missouri. In the naming of these vessels the Ocean Steamship Company has continued the policy of naming their vessels after Southern cities. Other cities which have been so honored in the past are Savannah, Atlanta, Columbus, Memphis, Macon and Birmingham, and with the exception of the latter all are now represented in the company's fleet. The vessels of the line maintain a schedule of three sailings weekly between New York and Savannah and two sailings weekly between Boston and Savannah.

The *City of Montgomery* and *City of St. Louis* were designed and built by the Newport News Shipbuilding and Dry Dock Company at their works in Newport News, Va., and represent the most modern practice in coastwise vessels, combining as they do excellent passenger accommodations with convenient cargo handling arrangements.

Their principal dimensions are as follows:

Length over all	398 feet
Length on water line	380 feet 10 inches
Beam, molded	49 feet 6 inches
Depth, molded to hurricane deck	35 feet

The vessels are of the familiar hurricane deck type, universally used in the American coastwise trade. They have three complete decks and an orlop deck both forward and aft of the machinery space, the machinery being located amidships. There is also a promenade deck extending from the stern to within about 80 feet of the bow. The boats are carried one deck above the promenade deck and a flying bridge is at this same level. There are two steel pole masts schooner rigged, the relative location of the masts and stack presenting a very symmetrical appearance.

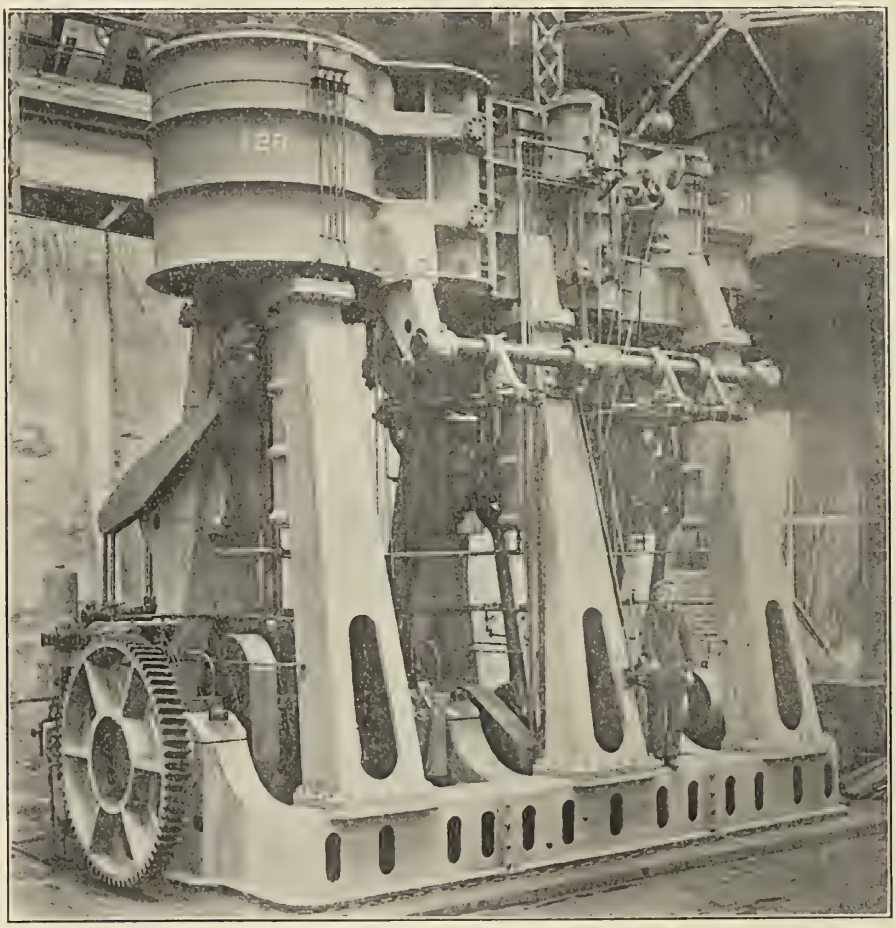
ONE OF THE NEW SAVANNAH LINE BOATS.

CONSTRUCTION OF HULL.

In one respect the construction of these vessels differs from the majority of passenger steamships in the coastwise trade. The latter are generally built without double bottom, or with only a partial double bottom in the machinery space, and only a few have complete double bottoms. In common with all the later Savannah Line vessels, the *City of Montgomery* and *City of St. Louis* have complete double bottoms extending from peak to peak. These are built on the cellular system with floor plates on alternate frames, excepting in the engine space, where floors are fitted on every frame. The frames in the double bottoms are cut at the margin, the latter being fitted normal to the frames. There are two side keelsons on each side of the vessels fitted intercostally between floors, and the vertical keel, which is 42 inches deep, is continuous from peak to peak, watertight throughout. At the margin the tank top plating overlaps the bilge brackets 18 inches, thus forming a very efficient tie.

Above the double bottom the main frames are channels extending from the margin angle to the main and hurricane decks alternately, excepting for a distance of 60 feet forward, where all frames extend to the hurricane deck. In the peaks the framing consists of angle and reverse bars. The four tiers of beams in the main hull are all channel sections fitted on alternate frames and supported by two rows of girders with wide spaced stanchions. This arrangement of stanchions intereferes less with the handling and stowage of cargo than

the usual small stanchions and has been adopted by the Newport News Shipbuilding and Dry Dock Company in most of the vessels built by them in recent years. The stanchions are cylindrical, built up of plates in the lower holds, and of wrought iron pipe in the upper. The girders under all decks consist of continuous double channels underneath the beams, with an intercostal plate which extends to the deck plating to which it is attached by angles. The orlop deck is fitted with stringers and tie plates and laid with a calked deck, over which 1 inch oak sheathing is fitted. The lower and main decks are complete steel decks without covering, excepting in way of quarters. An extra wide stringer is fitted on the hurricane deck so as to overlap the sills of the deck house; the rest of this deck is plated with light steel for protection against fire in the cargo space. Outside of the deck house this is entirely covered with a 3½-inch yellow pine calked deck and inside the house with a tongued and grooved joiner deck.



MAIN ENGINE OF THE CITY OF ST. LOUIS.

The hulls are divided into compartments by five watertight bulkheads, with one exception all extending to the main deck. There is also a non-watertight bulkhead between the engine and boiler rooms. Longitudinal bulkheads are fitted in the lower hold in way of the boilers, forming coal bunkers at the sides of the vessels. Engine and boiler casings of plate and angle construction extend from the lower deck to the top of the promenade deck house. The house on the hurricane deck is built of steel and stiffened at the forward end by webs.

Below the load water line the shell plating is joggled; above the water line the plating is fitted with inside and outside strakes. This method of plating is being largely used by the builders. In way of all cargo and coal ports reinforcing plates are fitted to maintain strength. A dished plate fender filled with pitch is fitted at the lower deck level and extends well forward and aft. The stem is rolled steel, rabbetted for the shell plating, and the stern frame is wrought iron made in two sections, with the scarfs so arranged as to facilitate repairs.

ACCOMMODATIONS.

In the passenger accommodations the builders and owners collaborated to make the *City of Montgomery* and *City of St. Louis* truly representative of the highest type of passenger vessels, and expense was not spared to put them in the very first rank. The traveling public demand comfortable and even luxurious quarters, especially on vessels making a voyage of any length, and as the sailing schedule of these vessels calls for a voyage of about 63 hours' duration, the comfort of the passengers has been especially catered to. In the design of these vessels this object was kept constantly in mind, and the result is a vessel with large, roomy staterooms, an unusually large number of baths, an especially attractive dining room, handsomely finished lounges, writing and smoking rooms, and wide, extensive promenades.

Accommodations are provided for 130 first class, 36 second class and 57 steerage passengers. All first class accommodation are entirely above the hurricane deck, there being 38 staterooms and 2 special bedrooms in a steel deck house on the hurricane deck, and 21 staterooms and 4 special bedrooms in two wooden deck houses on the promenade deck. The second class quarters are located on the main deck aft and the steerage on the main deck forward.

At the forward end of the hurricane deck house is located the dining saloon with a seating capacity for 124 people. In this space the deck above is raised so as to give a deck height of 10 feet 6 inches, and the result is a saloon having an ap-

pearance of roominess such as is only obtained on the most modern trans-Atlantic liner. The general type of decoration here is French Renaissance, the finish being white with gold trimmings, above a low wainscoting of mahogany. Paneled ceiling and four Corinthian columns in the center enhance the beauty of the saloon. In the space between the promenade deck outside and the top of the saloon inside, transom lights of leaded glass are fitted which add materially to the appearance, and these, together with the large windows, which are fitted in pairs at the sides of the house, make a saloon particularly well lighted. The electric fixtures are bronze of very attractive design, and are so numerous, and so well located that the illumination at night is remarkably fine. A large, handsome sideboard of mahognay set in a recess at the after end forms a very attractive feature. The dining tables and chairs are mahogany, the latter upholstered in a red figured tapestry. A Royal Wilton carpet covers the entire saloon floor.

Aft of the dining saloon, to which it has convenient access, is the first class pantry, a large, roomy space exceedingly well lighted and ventilated by means of overhead skylights. The floor is laid with mosaic tiling and the outfit is of the most modern type, including steam table, urns, etc. Food is conveyed from the galley, which is on the main deck directly below the pantry, by means of a dumb waiter and a private stairway, all enclosed so that no objectionable odors from the galley can escape into the dining saloon. From the dining saloon inside passages on each side of the machinery casings lead to a social hall or lounge located aft of the engine hatch. Single rows of staterooms with access therefrom are fitted along these passages, two of the rooms on each side having a private bath and several of them being arranged with communicating doors for use as family rooms. Immediately aft of the social hall are two special bedrooms with private baths. These rooms are nicely paneled and are fitted with large

VIEW ON PROMENADE DECK.

brass beds. The balance of the space aft is devoted to staterooms, with toilets and baths at the extreme end. Other toilets are located between the boiler and engine hatches, with access from an athwartship passage. All baths and toilets have tiled floors. The fact that there are twelve bath rooms for the exclusive use of first class passengers indicates how complete the toilet arrangements are.

At the after end of the after house on the promenade deck and opening thereon is located a reading and writing room, access to which is obtained also from the hurricane deck by means of a mahogany stairway and from the upper social hall by a wide central passage between rows of staterooms. At the head of the stairway, in the end of the house, is a handsome leaded glass window, the design on the *City of St. Louis* portraying King Louis IX of France, in whose honor the metropolis of Missouri was named. His coat of arms is worked in a handsome panel directly underneath the window.

MAIN DINING SALOON.

On the *City of Montgomery* the window has an appropriate marine design with a similar panel underneath. Several handsome mahogany writing tables with attractive electric fixtures, also a large table for magazines, are located in the writing room.

Like the dining room, the style of decoration in the writing room, upper and lower social halls, and passages is French Renaissance, the finishing being ivory and white. Upholstery and carpets in the writing room and upper social hall are green; in the lower social hall and stateroom they are red. All upholstery in public spaces is figured plush, except in the smoking room, where Spanish leather is used.

The upper and lower social halls or lounges are large, comfortable spaces connected by a wide mahogany stairway, over which is fitted a large handsomely lighted dome skylight, of prismatic glass. A large mirror is fitted at the head of this stairway. Off the upper social hall at its forward end, on either side, is a special room with private bath. These rooms are handsoemly paneled with silk tapestry, one in green and the other in old rose. These colors are also used in the tile wainscoting in the private baths attached. The bedrooms have full size brass beds, a roomy wardrobe and full-length mirror, making them truly elegant rooms. The other two bedrooms with private baths on this deck are located aft of the upper social hall.

Another room to which special attention was paid is the smoking room, located on the promenade deck forward of the boiler hatch. This is an especially large room, handsomely finished in mahogany. The style of decoration is old English, with tapestry panels. The hand carved lion heads are particularly attractive. A large decorated dome, the full length of the room and almost its entire width, accentuates the appearance of roominess. Rubber top mahogany tables, comfortable chairs, leather upholstered seats, writing tables, comfortable settees and rubber tiled floor make this an ideal room for male travelers. Access to the smoking room is obtained by an enclosed stairway from the passage on the hurricane deck as well as from the promenade deck direct. There is also a toilet room off the smoking room.

All the regular first class staterooms have two mahogany

berths, the upper one arranged to fold up like a Pullman berth. There is also a wide full length upholstered seat in each room. The lavatories are porcelain, and all the toilet fixtures in the staterooms, as well as in the bath rooms and toilets, are nickel plated, including the mirror frames.

An important feature not to be overlooked is a completely equipped barber shop located amidships on the hurricane deck. The deck in this shop is covered with white rubber tiling and the outfit includes a lavatory with hot and cold water and shampoo attachment.

Accommodations for the 36 second class passengers are provided in 12 staterooms of 3 berths each loacted on the main deck aft. A good sized cabin well lighted by a skylight overhead is also provided for their use. Berths for 18 women and 39 men are provided in steerage quarters on the main deck forward, this space being entirely separated from all other quarters and having its own companionway. There is also a separate steerage pantry with steam table and urns. All berths for second class and steerage passengers are metal.

While the comfort of pasengers has been so well taken care of, that of the officers and crew has by no means been neglected, and among seafaring men these vessels will most assuredly have a reputation of being "a good berth." The captain's cabin in its finish and decoration is equaled by few and surpassed by none. It is handsomely paneled in quartered oak, with paneled ceiling, is well lighted by a decorated overhead skylight and has a desk and table specially designed to match the finish of the room. There is also a private bath for the captain. Quarters for the deck officers are located on the promenade deck just aft of the captain's cabin.

A stateroom and office for the chief engineer are located on the hurricane deck opposite the engine casing, and the purser's office and stateroom are on the opposite side, the office having a window opening into the lower social hall. All other engineers' and crew's quarters, excepting the waiters, are on the main deck amidships abreast the machinery casings. These quarters include an officers' mess room and separate shower baths for the deck and engineer officers. The waiters are quartered at the after end of the main deck.

The galley, bakery, dry stores and cold storage rooms are located on the main deck amidships and are equipped with all modern conveniences. Throughout the vessels, companion ladders are located in convenient places for access to and from all decks. In order to give an unobstructed promenade the life boats are located at the level of the top of the promenade deck houses, the top of these houses being carried to the sides of the vessel to form a boat and shade deck. Other parts of the promenade deck, are provided with canvas awnings.

CARGO ARRANGEMENT.

The cargo capacity of these vessels is quite large, being about 325,000 cubic feet, most of the space up to the hurricane deck being devoted to cargo. The cargo usually carried is general merchandise which is handled by trucks through cargo ports. At times, however, bulky articles are carried, and for the handling of these two booms with a lifting capacity of 10 tons each, are fitted on a table on the foremast for use over the forward hatch, which is the only cargo hatch in the hurricane deck. In the other decks there are four hatches, two forward and two aft, the latter arranged in pairs to straddle the shaft alley. At each of these hatches on the main deck there is located an 8 inch by 8 inch double drum steam winch and two swinging cargo cranes, by means of which cargo is handled. The loading and unloading in the after holds is done entirely through cargo ports of which there is one on each side of the vessels between the main and hurricane decks and one between the lower and main decks. There are also two cargo ports on each side forward between the main and hurricane decks and one between the lower and main decks. All cargo ports are fitted with watertight doors, those between the main and hurricane decks being hinged in two parts, and those between the lower and main decks being of the sliding type with small hinged doors fitted in them for use in operating.

The vessels are coaled through two hinged ports located on each side between the lower and main decks. Through these ports coal is taken direct into the upper bunkers, and the lower bunkers are filled through scuttles in the deck. The total capacity of the bunkers is 450 tons, evenly divided between the upper and lower bunkers, this capacity being sufficient for a round trip. As the vessels are coaled in New York for the round trip, the upper bunker space is available for cargo on the return trip, and this space is so arranged, water-tight doors being fitted in the bulkheads at the forward and after ends of the bunkers for access from the regular cargo space.

The space between the lower and main decks aft over the after peak is arranged for carrying combustible goods, a water-tight door in the bulkhead forming access to the space.

HULL AUXILIARIES.

A steam windlass is located on the main deck forward and a warping capstan driven by the windlass engine is located on the hurricane deck directly over. On the hurricane deck aft there is another steam warping capstan with the engine in the base of the capstan. Steam steering gear is fitted, the engine being located on the main deck off the engine room. Hand steering gear of the right and left hand screw type is also provided on the hurricane deck aft. All the deck machinery was supplied by the Hyde Windlass Company, Bath, Me.

The vessel is heated throughout by steam and lighted by electricity, the fixtures being exceedingly handsome. The electric plant consists of two 20 kilowatt 110-volt generating sets, located in the lower engine room. The running lights are combination oil and electric and a running light indicator is located in the pilot house. There is a complete call-bell system connected to all staterooms, etc., and also a complete system of interior communication consisting of engine, steering and docking telegraphs, the latter being located on the flying bridge and on the promenade deck aft. Wireless telegraphy is also fitted with a completely equipped station on the promenade deck adjoining the smoking room.

PROPELLING MACHINERY.

The propelling machinery consists of a triple expansion engine with cylinders 26 inches, 43 inches and 72 inches diameter respectively and a common stroke of 48 inches, four main boilers of the Scotch type and one Scotch donkey boiler. Piston valves are fitted to all cylinders, one on the H. P. and two each on the M. P. and L. P., all worked by Stephenson double bar link motion. The housings are fitted with crosshead guides, both front and back, and they as well as the bedplate are cast iron of box section. The crank shaft is built up in three interchangeable sections, the thrust bearing is of the horseshoe type, and the propeller is a sectional one, with cast iron hub and manganese bronze blades. Steam turning and steam reversing gear are fitted. The air pump and two bilge pumps are worked from the L. P. crosshead, but the condenser and all other auxiliaries are independent. The condenser is cylindrical, with cast iron shell, and the circulating pump is of the centrifugal type of the Newport News Shipbuilding and Dry Dock Co.'s standard make. All other pumps are horizontal duplex and comprise two feed, one donkey feed, hotwell, fire, sanitary, fresh water, and ballast pumps. There is also an auxiliary condenser with a combined auxiliary air and circulating pump for port use. A feed

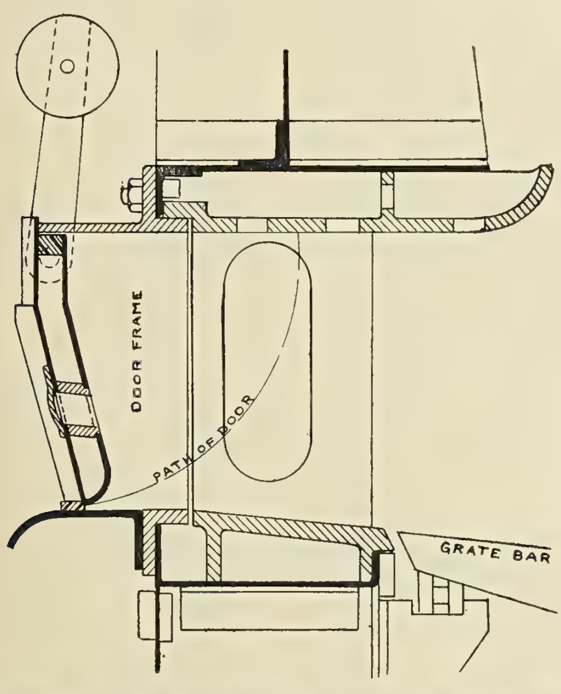
water heater is also fitted, it and all steam pumps being of the Blake type.

The four main boilers are arranged with a common athwartship fireroom and all are connected to one stack. They are 14 feet diameter by 11 feet 6 inches long, built for 180 pounds steam pressure and each has three 43-inch Morrison corrugated furnaces with separate combustion chambers. The total heating surface is 8160 square feet, and the grate surface 258 square feet. The donkey boiler is located on the main deck and is 10 feet diameter by 9 feet 6 inches long, with a working pressure of 90 pounds. It has two 35-inch Adamson furnaces and 177 3-inch tubes, giving a grate surface of 32 square feet and a heating surface of 1084 square feet.

The vesels were built throughout under special survey of the American Bureau of Shipping to class A1 for twenty years, the classification including the hull, machinery and electric plant.

Inswinging Furnace Doors.

A London engineer, W. A. Martin, patented the inswinging furnace door in 1874. It was applied extensively on the then commonly-used shell boiler, but gradually went out of use. Owing to its demonstrated merit in being automatic in closing it has again come into extensive use, especially on watertube boilers. The handiness and readiness with which it may be opened and closed as well as the protection it offers in case of the bursting of tubes in preventing the rush of steam from reaching the boiler room by its closing automatically renders it a most valuable adjunct when fitted in large boiler installations having closed fire-rooms.



SECTION THROUGH FURNACE MOUTH, SHOWING DETAILS OF DOOR.

Referring to the figure, showing the door as attached to a Niclausse boiler, its simplicity is strikingly in evidence, and a change from the ordinary outwardly opening door to this type of door is easily made, should it be desired. It is ordinarily composed of a door frame having a bearing for the pivoted hinge, which is riveted to the upper edge of the door. The lintel and deadplate are fitted between the frame and the furnace. The pivots extend beyond each bearing sufficiently to attach the arms which carry the balance weight, the door frame extending outward far enough to allow the proper clearance between the front of the boiler and the balance weight.

The construction of the front wall of most watertube boilers is usually of such nature as to provide space enough for the door within said front wall to be at rest in a natural pocket, thereby being fully protected from the action of the fire or the intense heat within the furnace.

In order to render the door as sensitive as possible the balance weight can be adjusted into a position where only the slightest pressure back of it will start it moving, as would be the case in a sudden rush of steam from within. The slight vacuum formed in front of the door, should steam escape at high velocity, undoubtedly serves as an additional agent to promote its action.

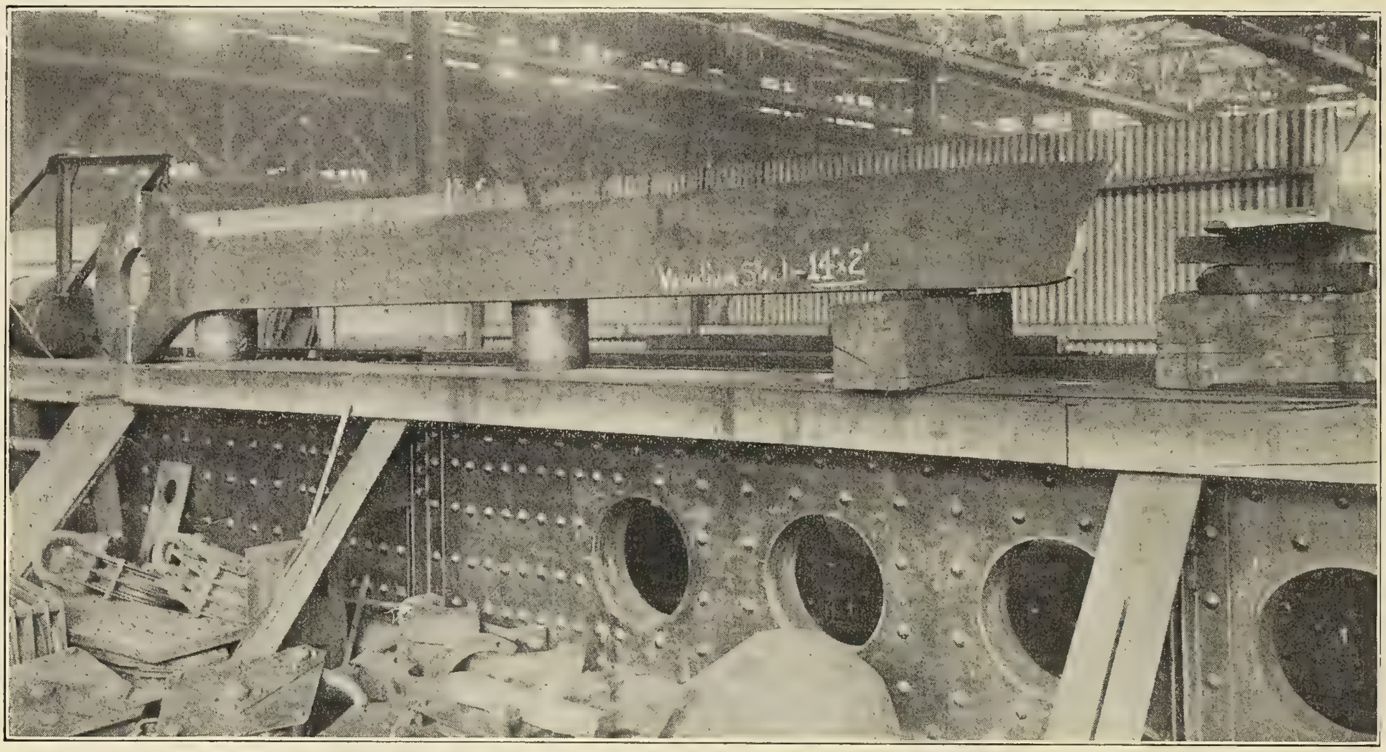
It has been found of such great value in several instances where fitted on boilers now in service on board United States naval vessels that all new boilers, in which coal is used for fuel, are being specified to have this type of furnace door, and the change is also incorporated in the older boilers as opportunity offers.

Whaling Vessel Sheathed with Leather.

An interesting log book has been brought to our office of the ship *Atlas*, 249 tons, which sailed under command of Captain James Townsend from New York, September 10, 1826, for the coast of Brazil on a whaling voyage. The log states that this ship was sheathed with leather, but unfortunately gives no statement as to how satisfactory leather sheathing proved. The only reference to it is under date of October 4. "Latter part (of day) hove aback to mend our leather."

According to the *Army and Navy Register* the two new revenue cutters authorized by Congress will be of the full spardeck type, 200 feet long, 34 feet beam, with an extreme draft of 15 feet. The engines will be vertical, triple expansion, reciprocating, with a stroke of 36 inches, and will develop 1,800 indicated horsepower under natural draft and 2,000 indicated horsepower under forced draft on the closed stokehold system. Two Babcock & Wilcox watertube boilers will supply steam. Under ordinary good cruising conditions the speed is to be 14 knots for a period of eight hours; the maximum speed under the same conditions is to be 15 knots. The coal capacity is to be not less than 300 tons, and the radius of action about 4,500 nautical miles at economical speed. The fresh water capacity of each vessel will be 17,000 gallons, exclusive of fore and after-peak tanks.

The designs for four new Russian *Dreadnoughts*, now under construction, are being severely criticised. These vessels are said to be 590 feet long, 89 feet wide and 27 feet 3 inches deep, with a displacement of 23,000 tons. They are designed for a speed of 23 knots, the engines being of 42,000 horsepower. The principal criticisms are directed at the armor and armament. The former is considered altogether too light for modern battleships, while the latter involves features which have been severely condemned by other naval authorities. The main armament is to consist of twelve 12-inch guns, arranged in four turrets, three guns in each turret. The secondary battery is said to be so located that the guns cannot be served when the 12-inch guns are being fired. The vessels are also said to be deficient in boiler power. In order to keep the weight of hull and fittings as small as possible, it was decided to use high tensile steel, as it was thought that by so doing the scantlings could be materially reduced throughout. There are two objections to this, however. The first is that reducing scantlings destroys the stiffness of the structure, and the second is that Russian steel makers cannot produce sufficient high tensile steel of the proper quality.



VANADIUM STEELS

For Structural Work

This photograph represents a full sized eyebar of Vanadium Steel, 14 ins. wide, 2 ins. thick, 27 ft. long. It was tested to destruction at Ambridge, Pa., and gave a tensile strength of 99,890 lbs. per sq. in.; elastic limit, 80,840 lbs. per sq. in.; reduction of area at fracture 52.3%; elongation in 12 inches, 32.5%; elongation in 20 feet, 7.9%.

A number of similar bars were also tested and gave similar results.

We are confident that Vanadium Steel will solve the serious problems that every Bridge Designer is obliged to meet in order to satisfy modern requirements.

Vanadium Steel gives what no other type of steel has been able to give in static and dynamic qualities, at a price that permits its employment in the largest structures, and at every point where maximum results must be secured. Correspondence on this intensely interesting subject is invited.

AMERICAN VANADIUM CO.

318 Frick Building, Pittsburgh, Pa.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Accidents Attributable to Design and Inexperience in Operation.

Excellent workmanship and good materials in the construction of marine engines are not alone sufficient for successful operation. Carelessness and faulty design, especially when followed by inexperience of the fundamental principles upon which operation of machinery should be conducted, are often the causes of serious accidents.

Therefore it may not seem altogether equitable to hold a contractor responsible for the working of machinery built on plans and specifications which are not his own, nor to hold the superintendent of construction responsible for defects that develop purely as the results of bad design or neglect in maintenance. Yet circumstances often place the blame of unfortunate accidents to machinery on the persons that are not to blame.

Some years ago a contract was awarded to build, on plans and specifications furnished by the owners, a certain type of steamer equipped with, what was considered then and probably is now for that type of boat in the way of general design, a modern and up-to-date machinery installation, although the details were in many respects wanting. The machinery consisted of a triple-expansion engine with all necessary auxiliaries, two cylindrical boilers with corrugated furnaces and independent combustion chambers, a complete installation of electric light machinery besides independent machinery for wrecking and drainage service.

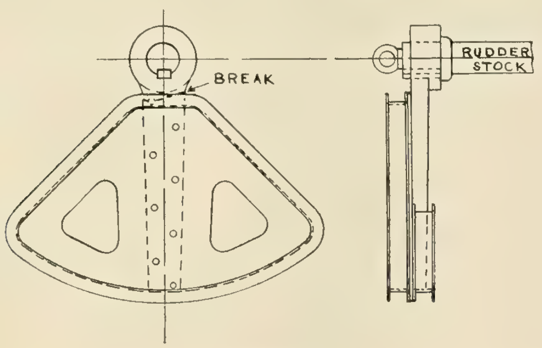


FIG. 1.

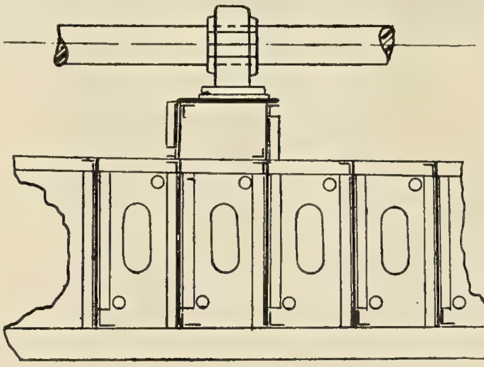


FIG. 2.

The engine cylinders were 16½ inches, 27 inches and 46 inches diameter by 35 inches stroke, with a piston speed giving about 110 revolutions per minute when working with 165 pounds steam pressure at the high-pressure cylinder. This cylinder had a piston valve with solid rings, the intermediate-pressure cylinder had a single-ported, unbalanced slide valve, which was also the case in the low-pressure cylinder, except that the slide valve here was double ported and was provided with a balance piston. The valve gear consisted of the Stephenson link motion, double bar and cast iron eccentrics, with straps of the same material without white metal linings. The main steam pipe connected direct from the boilers to the throttle without a separator. By-pass valves were fitted to both receivers, and besides the regular throttle and reversing gear efficient gear for oiling and water service was fitted complete throughout the engine. The main journal bearings had bottom brasses with white metal lining, while the top bearings consisted of cast steel bearing caps, white metal lined. The workmanship was generally excellent throughout, and the construction had the appearance of substantiality. A successful trial trip, and as a result thereof the delivery of the ship, was consummated.

Gradually but surely, however, one defect after another developed. First, a very noticeable wear developed in the after (low-pressure cylinder) bearings. Cylinder heads cracked, and kept on breaking despite their thickness being greatly increased when rebuilt. Then were heard complaints of heavy vibration in the valve gears and of the engine cylinders. On one occasion while under way, under apparently ordinary working conditions, the ahead eccentric rod of the intermediate-pressure valve gear broke, twisting itself into a shape suggesting the appearance of a bow.

At times considerable water was carried over with the steam into the cylinders, keeping the relief valves popping and douching the engine-room force. Just when starting on a trip on a certain occasion the cylinder cover of the electric light engine broke, disabling the electric light plant and putting out of commission all lights, as the storage batteries, of which there was a complete installation, had been allowed to run out without recharging. The boilers gave no trouble except for occasional foaming, and the ship generally stood up well against its oftentimes extremely severe service. One exception was the breaking of the rudder quadrant, Fig. 1, at the root of the tiller, not from any flaw in the forging but from strains not provided for in its design. The spare tiller carried on board was rigged up, and the ship reached its destination safely. The foundations, Fig. 2, of the steady bearings became loose from working, due to improper disposition of their scantlings and faulty construction. The forward crankslab twisted out of position, causing disarrangement in the alinement of the high-pressure crankpin.

It became very evident to those concerned that a series of different causes contributed to this most unsatisfactory state of affairs, and to prevent complete disablement, remedies had to be found and applied.

CAUSES.

A primary cause for many ills exists in the fact of overrating one's capacity. The most serious troubles with the engine in question were undoubtedly due to the attempt to develop power of which it was incapable, and which could only be procured at a penalty. The engine, it is believed, was designed for about 1,100 horsepower, which could not be

obtained with the size of high-pressure cylinder provided and ordinary work of expansion, but was secured by admitting live steam directly into both receivers.

It may be readily conceived, even by those not fully conversant with theoretical engine design, that a definite steam weight, as represented by the cylinder volume before cut-off at a certain pressure or density, allowing for known losses for the type of engine chosen, is necessary to develop a given horsepower, the steam weight thus admitted being meanwhile expanded down to a given terminal pressure in the other cylinders. If the original steam weight admitted at the beginning of each stroke, or, in other words, the piston area, together with its speed, is not great enough, then the difference in steam weight required for the horsepower must be admitted direct to the other cylinders to give the stipulated power. This is commonly done through the by-pass valves to the receivers. This action results often in serious differences as to the work developed by each cylinder, the low-pressure cylinder usually giving the highest power, then the intermediate-pressure cylinder, while the least is obtained in the high-pressure cylinder, being due to increased back pressure on each succeeding cylinder from the low-pressure cylinder on.

Owing to the highly unequal work developed by the cylinders inharmonious loads are transmitted to the bearings with excessive wear on those most heavily loaded.

A more serious question, however, arises through the augmentation of receiver pressures, especially when the valves, as were the conditions in the engine in question, are of the unbalanced slide valve construction. The pressures on these valves were, respectively, in the intermediate-pressure and low-pressure cylinders under ordinary running with by-passes closed about 12 and 6 tons, and considerably more when open. The friction between valve and valve seat to be overcome, together with the inertia forces, brought a very excessive strain on the valve gear, causing at the same time undue vibration. Add to these severe conditions the omission of continuous and skillful lubrication of the gear and the eccentrics, which, as mentioned before, were working cast iron on cast iron, and the results are obvious. Investigation later actually demonstrated that the eccentrics of the intermediate-pressure valve gear had been running without proper oiling for some time previous to the accident. The natural result was heating and abrasion, together with expansion of the metal so great that a firm grip by the strap on the sheave made further turning impossible. Strap and sheave therefore practically became one, with the motion bending the lower end of the rod and pulling the entire valve gear downwards as far as the valve chest would permit, until the stress finally was transmitted through the length of the rod to the upper neck, at which place the rod broke. After breaking the rod struck the bedplate, and was carried around by the eccentric until twisted into a complete bow before the engine was stopped. The gear and valve were removed, and the trip continued with the engine working compound with the high-pressure and low-pressure cylinders.

To have water carried over with the steam into the cylinders is a serious drawback, and the cause of such occurrence apparently originates in different ways. In the case which we have before us the cause was plausible enough. The boilers were 13 feet 3 inches in diameter, with the stop valves about 14½ feet from the inner bottom, and the height to the throttle inlet at the middle of the valve chest on the engine was about 13½ feet, counted from the same base, which, together with the trim by the stern of the ship, produced a net incline in the main steam pipe leading from boilers to engine of nearly 1 foot. Saturated steam nearly always contains a percentage of moisture, which, together with the water carried over, in case of foaming and under conditions outlined, owing to gravity, drained into the engine instead of into the boiler, where it would be harmless. The greater part of the water coming over as indicated may be taken up with a separator. This device, however, was omitted in the design. In engines of long stroke, with the steam inlet considerably above the boiler outlet, no separators are needed and are not fitted, but they should be fitted when the relative position of engine and boiler is such as to render flow by gravity towards the engine certain. Aside from the economic loss sustained by water being admitted to the cylinder no other damage need be sustained if efficient means are provided for eliminating its action, usually done by cylinder relief valves. If these valves are tampered with, however, as by setting up on the springs or removing the valves entirely and plugging the holes, trusting to luck to care for consequences, then in ten cases out of ten such trouble will ensue as breaking of cylinder heads and other strained situations as were here experienced.

An essential precaution before starting up an auxiliary engine, or any engine, be it reciprocating or turbine, consists in opening all drains so as to get rid of the water which, by condensation, is bound to accumulate in the steam piping or in the engine when standing. Long steam pipes usually have and should have for protection a stop valve near the boiler, or where a branch pipe joins the auxiliary pipe. Such valves are, unfortunately, difficult to keep absolutely tight, and for that reason leakage occurs. If suddenly opened, at the same time starting the engine, a large amount of water finds its way into the cylinder, flooding it completely if it is small. A few revolutions in a quick-turning engine, like dynamo engines, may, under the conditions cited, cause irreparable injury. The top cover is generally much weaker than the bottom of the cylinder, and, as happened here, is the member that is smashed.

The electric light engine, which was directly connected to the dynamo, stood on the main engine floor plates, and had thus the benefit, so to speak, of a long steam sleeve, shaped to effectually trap all the steam that condensed in it. A careful artificer sees to it before starting his engine that the entrapped water is drained off.

While a built-up crank-shaft may be made as rigid as a solid shaft it is very important to be sure that all crank arms are shrunk on under sufficient pressure to ensure rigidity, and, moreover, to fit the keys to bear tightly not only top and bottom but also on the sides. The forward crank arm, theoretically, sustains no other torque than that due to friction in the forward journal, which is immaterial, and the key here was either overlooked entirely or badly fitted, hence the disarrangement of the pin with the consequent eccentric motion of the journal, which no amount of ordinary adjustment was sufficient to remedy.

While it may appear to one who only casually observes the function of steady bearings, placed at different points along the length of the line shafting, that they only oppose the pressure caused by the weight of the shaft, it soon becomes apparent that there exist besides both lateral and fore and aft stresses. These have to be effectually provided for in the design and construction of the foundation. Building these foundations, as was done in this engine, of a couple of vertical plates riveted to the standing flange of adjoining frames, with a foundation plate fastened at the top without further intercostal or diagonal bracing rendered the foundation insecure, and after a few months' operation every rivet became loose and the entire structure unfit to carry the bearing with steadiness. The breaking of a shaft may have resulted from such cause, but the mischief was discovered in time.

REMEDIES.

While the nature and cause of these numerous and annoying accidents was fully understood it became of concern to those interested to apply such remedies as would result in the least delay in the service of the ship, at the same time to obtain a smooth working valve gear and engine with but little reduction in the engine horsepower.

In order to equalize the work among the three cylinders, cards were taken before any change was made, giving the following results:

High-pressure	239.3
Intermediate-pressure	432.2
Low-pressure	419.7
Total	1,091.2

Vacuum gage	25½ inches.
Revolutions per minute	112
Intermediate-pressure receiver	70 pounds gage.
Low-pressure receiver	12.8 pounds gage.

The first alteration consisted in renewing all eccentric straps, lining same with white metal.

The next change involved resetting of the valves at the same time redesigning the laps, cut-offs, leads, releases and compressions so as to reduce the receiver pressures with earlier cushion. This was done in the following manner:

The angular advance on the low-pressure valve gear was reduced from 36¾ degrees to 34¾ degrees by throwing the eccentric back and fitting a new key having a jog above the

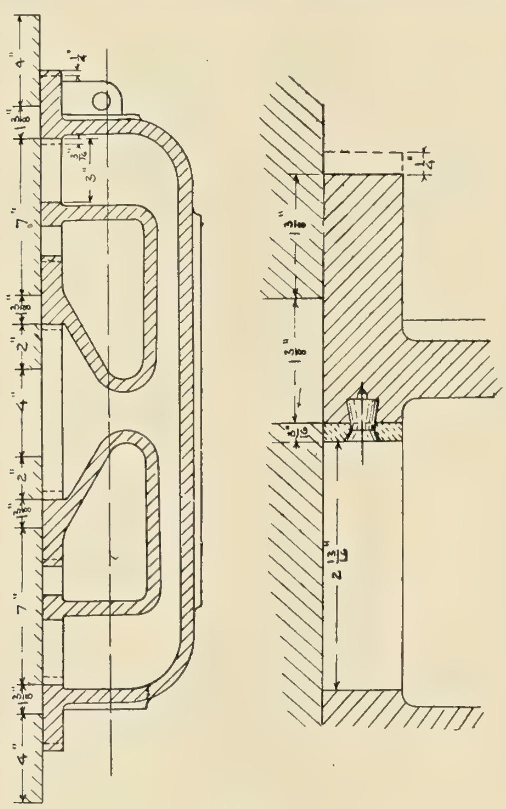


FIG. 3.

shaft. The steam laps were cut off ¼ inch and 11/32 inch top and bottom, respectively. The exhaust laps were added to 3/16 inch and 5/16 inch, respectively, top and bottom, Fig. 3. Then,

		Inches.
Steam lap top		1⅜
Exhaust lap top	+	3/16
Steam lap bottom		1 5/16
Exhaust lap bottom	+	5/16

Reducing the steam laps was easily performed by cutting down original laps in a planer, but the addition of exhaust laps was more difficult. It was consummated, however, by riveting planed brass strips to the inside ports of the valve, using soft brass rivets in conical holes cut by a special drill in the edges of the valve. The cut-off was thus changed from .68 to .75, the lead and compression beginning at an earlier stage than before.

It was desirable, also, to throw back the intermediate-pressure eccentric, the angular advance of which was 34½ degrees; but this was not done owing to it being impossible without first raising the shaft, for which there was no time. Similar changes to those made in the low-pressure valve were made, however, in the intermediate-pressure valve, in order to secure a steam distribution giving the same results as aimed for in that cylinder. The cut-off was thereby changed from .7 to .78, with leads, compression and releases in accordance. The changed laps for this cylinder were:

		Inches.
Steam lap top		1 9/32
Exhaust lap top	—	1/16
Steam lap bottom		1 7/32
Exhaust lap bottom	+	1/16

The high-pressure eccentric, which originally had 31 degrees angular advance, was not reset, but steam laps were cut off 3/16 inch and 7/32 inch top and bottom, respectively, as were also the exhaust laps 3/16 inch and ⅛ inch, giving the following laps for this cylinder:

		Inches.
Steam lap top		1 7/32
Exhaust lap top	—	3/16
Steam lap bottom		1 3/16
Exhaust lap bottom	—	1/8

This produced a change in cut-off from .75 to .79. Owing to the fact that the eccentric rods in this gear were crossed a slight amount of "linking up" changed the cut-off rapidly without materially altering leads, compression or releases, which proved of great advantage in final adjustments. All valves had 6-inch throw.

The effect of the foregoing changes may be appreciated from the following results obtained from cards after changes had been made:

High-pressure cylinder	301.4
Intermediate-pressure cylinder	376.8
Low-pressure cylinder	368.7
Total	1,046.9

Revolutions per minute	105
First receiver	62 pounds gage.
Second receiver	9.2 pounds gage.
Vacuum	26 inches.
Boiler	168 pounds gage.

As the foregoing changes were made with a view to secure a smoother and easier working valve gear it became interesting to note the results. Not only did the engine permit of easier handling, but there was also almost an entire absence of vibration in the gear as well as in the engine as a whole. By increasing the volume, through lengthened cut-off in both cylinders, the receiver pressures were correspondingly lessened, at the same time as the back pressure was reduced on the high-pressure piston, adding to the power of that cylinder. While the cut-off by the change made in this cylinder was lengthened with an earlier lead a small amount of "linking up" brought the cut-off to normal, while the lead and other quantities remained practically unchanged, owing to the fact that the rods were crossed.

By a slight change in the lead of the steam pipe, obviating the drain of the entrained water in the steam towards the engine, together with the addition of a separator, no trouble was further experienced from water in being carried over towards the cylinders.

All the relief valves were refitted and readjusted, thereby insuring safety. The foundations of all steady bearings were

rebuilt with brackets and intercostals to compensate for both fore and aft and lateral stresses existing. All bends and lines of piping where there existed any possibility of condensed steam and water collecting were furnished with efficient drains.

When rebuilding the rudder quadrant the dimensions of the arm were increased so as to give a sectional area almost twice what it originally was, beside carrying the chain plate well over the boss, giving a better distribution of material. The spring bearing foundations were strengthened with intercostal plates and angles to resist fore and aft movement.

With the above changes, together with careful operation and efficient maintenance, the machinery afterwards worked satisfactorily. D. C.

An Experience with a Sea-Cock.

Next to absolute safety, simplicity should be most aimed at in all parts of the machinery of a ship, but in no place perhaps is there greater need of careful consideration than in the arranging and designing of the sea and bilge fittings, so that through neither accident, carelessness nor ignorance on the part of an engineer can the safety of the ship be endangered. It is unnecessary to say here how easily a vessel may be flooded by a badly arranged system of sea-cocks in ignorant or inexperienced hands, for it is self-evident to every engineer; nor is it necessary to recapitulate the names of vessels that have foundered from accident to or neglect in the careful working of these fittings, for almost every engineer has heard of them.

Lloyd's Committee have issued special rules on this subject, and the Board of Trade and other similar corporations are no less vigilant in endeavoring to eliminate every source of danger. The Board of Trade regulations, referring to sea connections, say that: "All inlets or outlets in the bottom or side of a vessel, near to, at, or below the deep-load waterline, other than the outlets of water closets, soil, scupper, lavatory and urinal pipes, should have cocks or valves fitted between the pipes and the ship's side or bottom; such cocks or valves should be attached to the skin of the ship, and be so arranged that they can be easily and expeditiously opened or closed at any time, and the cocks, valves and the whole length of the pipes should be accessible at all times." Cocks or valves standing exceptional distances from the ship's plating; that is, where the necks are longer than is necessary for making the joint, should not be passed without the sanction of the Board of Trade, and one condition of their being passed is that they should be made of gunmetal and well bracketed.

What mischief may be caused by a deficient sea-cock and its connections is fairly well illustrated by an experience the writer had some years ago, when engineer in one of the vessels engaged in the Belgian Mail Service, running between Antwerp and South American ports and River Plate. This steamer was equipped with a compound engine of about 2,500 indicated horsepower, of the old lighthouse or steeple type, *i. e.*, a single crank, with the high-pressure and low-pressure cylinders tandem, and having a 15-ton balanced fly-wheel 13 feet in diameter on the thrust shaft abaft the after bearing, which bearing also took the thrust from a large, single collar solid on the shaft, rubbing on a correspondingly large flange on the after end of the after-bearing brasses.

The rim of the fly-wheel was not more than 16 or 18 inches clear of the ship's plating, and ran between the two after frames in the engine room; it will therefore be evident from this fact that it was very necessary to keep the bilges as free from water as possible, otherwise if more than 18 inches of water was permitted to accumulate the engine-room soon became deluged with the bilge water flying from the rim of the wheel. The orders were not more than 9 inches in the bilges at the relief of the watch. On this particular occasion the vessel was well to the southward of the line, making for Rio Janeiro, when we ran into a pampero, and experienced very heavy weather for two days, the ship laboring heavily; the engineers were put on double watches, and one was required to be constantly at the throttle valve to ease the engines and prevent damage from the heavy racing. Large quantities of water had been shipped, coming down the fiddleys into the stokehold, washing coal and ashes into the bilges, and continuously choking the mud-boxes, stopping the bilge pumps, and it was only by putting the donkey pump to work, in addition to the bilge pumps, that we were at all able to keep the water below the stokehold plates, which, by the way, were some 5 or 6 feet lower than the bottom platform of the engine room. Everything generally was in a pretty uncomfortable state, as it was impossible to get the water down so that the rim of the wheel would not lift it and whirl it all over the engine room; canvas, meanwhile, had been placed over the fiddley gratings, the water service in the engine room and tunnel was shut off, and everything possible was done to reduce the water.

On the afternoon of the third day, when the weather was at its worst, the attention of the writer was arrested by the increased volume of water that apparently was being lifted by the fly-wheel; a hurried examination of the donkey pumps disclosed the fact they were working well, as the mud-boxes had only a short time before been cleaned. Sounding the bilges, it was found the water was rapidly gaining; all the engineers were called, and they were sent individually to make an examination for leaks in the boiler room, tunnel and engine room; the circulating pump and connections, condenser and all the piping arrangement, as far as could be seen below the plates, were examined, but without offering any solution to the mystery.

The situation was now becoming desperate. As the wing plates in the stokehold had been washed up the bunker doors in the wings had to be closed, and the water was now in the ash pits of the lower fires. The bilge injection was opened, and for some little time the water did not gain upon us; but, unfortunately, the tail pipe was not fitted with a rose box or basket, but had the end stopped up, and was perforated with a number of small holes, which soon became choked by the coal and ashes that had been washed into the bilges. Efforts were, of course, made to keep it clear, but owing to the depth and wash of the water it was impossible for a man to do this.

Meantime the writer was making a closer examination of the pumps, and in doing so unconsciously was feeling the plungers, when he was struck by feeling the pump plunger of the sanitary pump warm. Now, this pump was single-acting; worked from the inside of the pump levers, and was of short stroke. It had its own separate 2-inch suction direct from the sea, and should therefore, when working properly, have been cold. Following this clue he found the suction pipe also warm, and could not understand why this should be so.

The sea-cock for this pump was well down on the ship's bottom, and was covered by this time with 6 feet or more of water, so that it was only by diving that trouble here could be ascertained. This was a matter of no little danger and difficulty on account of the swirl of the water with every roll of the ship. However, it had to be attempted, and so fastening a rope under the arms, and getting the second engineer to stand by with men to haul when necessary, the dive was made, only to find the water pouring into the ship with tremendous force and velocity at this point. As far as could be felt the cock was intact, and very fortunately the cock was fitted with a ring similar to a blow-off cock, and arranged so that its handle or spanner could not be removed when open. It is probably owing to this that the vessel was saved. It required quite a few dives below the slimy, oily water before the cock was fully closed, but it was accomplished successfully, and the pumps soon

began to tell upon the water, but it was not before the lower fires were out entirely and the steam had fallen so low that the engines would scarcely go over the center.

It can readily be imagined that all breathed more freely as the water steadily receded in the bilges, and the stokehold plates were put in place again and the fires got under way. Soon after the weather moderated and Rio was reached in due course, where the bilges were thoroughly cleaned and the damage to the offending suction pipe repaired. It was found that the brazing of the copper pipe to the flange had given way, and the pipe had sprung back a clear foot from the flange, so that the South Atlantic Ocean had a clear 2-inch diameter hole to pour its water into our bilges.

Constant watchfulness and careful examination periodically should be made of all sea-cocks and connections to avoid danger, or, if possible, accident, for it is well known to engineers that mischief may ensue from the corrosive action of bilge water on metallic surfaces; iron corrodes quickly unless well protected, and Muntz metal has been found to decay in a peculiar manner, becoming so soft that it can be cut like plumbago. A good, thick coat of Portland cement will give protection at times, although the writer has found sea-cocks held in place only by cement, the through bolts having been entirely corroded away, and the thickness of the ship's plating reduced 50 percent under the flange of the cocks by corrosion and galvanic action. This has, of course, been remedied in drydock. Finally, sea-cocks and valves should be so placed that they are accessible practically at all times, and as far as possible within sight from the working platforms of the engine room.

John Creen.

Seattle, Wash.

A Peculiar Accident.

While visiting the chief engineer of an 8,000-ton steamship with a large triple engine, my attention was called to a brass plunger which had been removed to be replaced by a new one. The plunger belonged to the main feed pump and was part of an attached pump outfit, being driven by the air pump crosshead attached to the low-pressure engine. It was about 6 inches in diameter, and some 5 feet long, the upper end being tapered in the usual manner, to fit the air-pump crosshead, and with a thread on top. Cast brass was the material cored out on the inside, leaving the body about 3/8 inch thick. The curious feature of the accident to this simple part consisted of the fact that after long years of wear it had suddenly collapsed, a section through the middle roughly resembling a three-toothed gear. The grooves were nearly parallel and extended close to either end.

The pump to which the plunger belonged was of cast iron, bolted by a flange to a pad cast on the air-pump body. There were two valves, one suction and one discharge, cast with the pump, each with its usual bonnet. The valve seats were of brass, forced into the cast iron and doweled in place. The valves were of the usual check type, also of brass, with a 45-degree angle seat, whose lift was limited by a projection cast in the pump body. There were two relief valves discharging to the bilge, one connected to the chamber between the suction and discharge valves and the other in the discharge pipe, also the usual suction and discharge pipes which completed the outfit.

It was in the middle of a run of several hundred miles that the suction relief valve suddenly started to blow, discharging to its full capacity into the bilge. The pump was promptly cut out, the auxiliary feed and independent simplex pump taking its place. The plunger continued to run idly during the balance of the trip. When the first opportunity offered, both bonnets of the pump were removed in an effort to locate the cause of the trouble, but, strange to say, everything was found in first-class shape. An extended examination was then made by most every member of the engineers' force, but failed to locate any trouble. The pump was assembled and the next trip started, but the pump had to be cut out immediately, due to the same cause as before. A second examination proved no more than the first and a third attempt to use the pump ended in a similar manner. The conclusion was now reached that the trouble must be in the relief valve, so when it was discharging the nut regulating the tension of the spring was set up.

The effect was instantaneous; a column of water appeared to come up through the plunger, drenching that portion of the engine room and its occupants, which was not lessened until the auxiliary feed pump once more took care of the boiler feed. The broken-down plunger appeared to run all right in its place and no stop was made, but a very determined effort to locate the cause of the disaster was indulged in when the opportunity again came to hand.

After a considerable time the trouble was finally located in the discharge valve seat, which had sheared its dowel and had risen bodily, seat and all, when the water had collected below it. The above mentioned stop, limiting the lift of the valve, had not allowed the seat to leave the casting, but had effectively kept the valve closed. Upon examination as the valve and its seat were in their usual positions the evidence of the mischief was concealed. When the added pressure put upon the relief valve kept this from opening to release the water, it naturally found an outlet at the weakest point, which fortunately was the plunger and not the complicated pump-body casting.

As a spare plunger was carried aboard ship the damage was soon repaired; both valve seats being securely anchored in place, as a matter of course.

Camden, N. J. Wm. J. Auten.

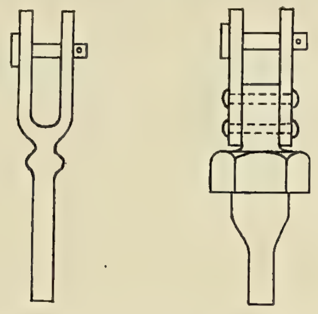
Squealing Valves.

It is the object of every good marine engineer to economize cylinder oil as much as possible, as it is an expensive item, and except where superheated steam is used the steam itself should afford quite enough lubrication for the valves and cylinders of the engine when once steady running has been started. The usual time when lubricating oil is required is when the boat is being worked out of port, and a certain amount of starting and stopping and slowing down may be necessary. Once, however, a steady run is obtained it should be possible to shut the oil supply, either entirely off, or down to a very small minimum. The ordinary D-flat valves, which are used in connection with high-pressure and medium-pressure cylinders of marine engines, have, however, a rather nasty habit of squealing. This not only spoils the valve faces, but the trouble involves the use of a lot of cylinder oil to keep the valves quiet. In one case of this kind the high-pressure valve was always making a noise, and when the boat arrived in port it always became necessary to deepen the oil-ways, which were found to be practically ground out. After some discussion of this problem it was decided to drill and tap holes all over the face of the valve 1 1/8 inches in diameter, and to screw into these white metal plugs. These were then riveted over in order to prevent any subsequent working loose, and were then filed off flush with the valve face. When it was put back again the valve was given a good flush of cylinder oil before closing up the valve, and this procedure was sufficient to cure the trouble. Twelve months afterwards the oilways were in perfect condition, and the squealing noise was entirely done away with, the white metal in the valve face being in itself a lubricant and saving a good deal of cylinder oil.

Chas. P. Starkweather.

A Broken Goose Neck.

A marine engineer often has to overcome trouble that does not strictly belong to his own department. Occasionally the deck officers get into trouble and then the man with the hammer and chisel is called in to get them out of it. On one occasion the goose-neck of a boom broke off at the fork, due



ORIGINAL GOOSE-NECK AND IMPROVISED ARRANGEMENT.

partly to a flaw in the forging, and also in some measure to excessive strain in working. It was impossible under the circumstances to forge a new one, but yet it was absolutely necessary to have the boom working in order to get a cargo into the vessel.

Fortunately, however, a small stanchion about the diameter of the spindle of the goose-neck was found on board, and one end of this was "jumped up" and flattened for about 9 inches along its length. Two holes about 1¼ inches diameter were then drilled through this flattened part, and two pieces of 1-inch plate were drilled, with holes to correspond. The three pieces were then riveted together, the flat plates projecting outwards and in the same straight line as the stanchion. These plates were each about 3½ inches wide. A large nut was fitted on the remaining "jumped up" portion of the stanchion to take the place of the collar in the original goose-neck, and the pin was taken out of the old goose-neck and fitted into the new arrangement. This, as a matter of fact, was the only part of the old arrangement which was placed in the new. The sketch shows a comparison of the original and improvised arrangement, the latter of which may, with all due modesty, be described as ingenious. OLIVER D. QUINCY.

An Exceptional Photograph.

On June 10, 1909, the steamship *Hyades*, of the Boston Towboat Company, sailed from San Francisco, Cal., on her regular trip to the Hawaiian Islands via Puget Sound ports. Shortly after leaving San Francisco she ran into a strong northwesterly gale with a big head sea running. The ship was light, carrying only her fuel oil (about 5,000 bbls.), and with the continual pitching was racing heavily, at times throwing her stern to such a height that the shoe could be plainly seen. When off Cape Blanco, on the Oregon coast, the writer devised a plan for obtaining the accompanying photograph of the propeller while racing.

A small boatswain's chair was rigged with guy lines leading fore and aft, sailors stood by each of the guy lines, and I was tied in the chair with another line made fast under my arms. The first mate and two sailors then lowered me over the ship's stern on the starboard quarter until I was on a level with the revolving blades. After five unsuccessful exposures, when both myself and the camera had to be hauled on deck several times on account of being completely submerged, I finally succeeded in getting the picture shown. It was taken at a dictance of 10 feet from the wheel, which was making over 100 revolutions per minute. This is supposed to be the only picture of its kind ever taken.

PROPELLER PHOTOGRAPHED WHILE RACING. (*Copyright by H. E. Rylatt.*)

The *Hyades* is 361 feet long, 47 feet beam, 28 feet depth, with at tonnage of 3,753. She is driven by a triple-expansion engine with cylinders 21, 35 and 56 inches diameter and 42 inches stroke. The indicated horsepower is 1,650, and the diameter of the wheel 14 feet 9 inches. The fuel consumption is one-half barrel per mile, or 1.2 pounds per indicated horsepower per hour. H. E. RYLATT.

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Naval School of Marine Engineering.

As announced last month, we are publishing in this issue a description of the new United States Naval School of Marine Engineering. This school is one development of the plan inaugurated in 1899 for the amalgamation of the engineer and line officers in the navy. Since that date the Naval Academy itself has been developed very largely along engineering lines, but from the nature of things the enginering work undertaken by the undergraduates of the Academy has been of a general nature, embracing many different branches, and there has been no opportunity for specializing in marine engine design. It is, perhaps, not too much to say that there is no branch of naval work which requires more thorough study or a broader knowledge of engineering than the subject of marine engine design. It is one of the fundamental branches of naval work, and the greatest efficiency cannot be maintained in the navy unless this important branch is developed to the highest degree. The establishment of the new post-graduate School of Marine Engineering is, therefore, a matter of no little importance.

While it is necessary that such a school of engineering develop a certain number of expert designers trained for the work in hand, yet it is evident that the institution would lose a valuable opportunity if it did not in some way influence the entire engineering personnel in the navy by stimulating interest in a broader and more thorough study of engineering subjects. In working out the details of the new school this feature has been kept in mind, and by making appointments to the school a reward for exceptional ability and achievement in engineering work, as well as arranging that such an appointment will lead to positions of increased responsibility and opportunity, it has already stimulated great interest in engineering work among the line officers, and appointments to the school are eagerly sought.

Although it is too soon to tell how well the purpose of the school will be accomplished, nevertheless the method of selection, the method of instruction and the disposition of graduates of the school indicate that the desired results will be achieved, and that in a few years the navy will be provided with an efficient corps of expert designing engineers. The method of selection, as outlined elsewhere in this issue, is one well calculated to secure not only men of exceptional mental qualifications, but also men of practical achievement, who have had an opportunity to show their worth in practical engineering work. Naturally, with such students as these the method of instruction adopted in the school must be such that the students will have ample latitude for original work and the carrying out of their own ideas. In fact, much of the work of the school will be research work, and it will consist largely of individual reading and investigation.

It has frequently been said that a designer is merely a copyist who carries the work of his predecessors a step further. This is true, and, therefore, the education of designing engineers must necessarily embrace a thorough knowledge of the methods and work of previous designers. If any adverse criticism of the school were to be made, it probably would be that the time allotted to the actual work of designing is rather meager. However, a few years' experience will show whether this is so or not.

Comparative Cost of Operating American, British and German Steamships.

In the course of an investigation which is now being carried on before a special committee of the American House of Representatives in connection with certain matters relating to ship subsidy legislation, some interesting data regarding the comparative cost of operation of American, British and German steamships were brought out by Mr. A. H. Bull, of New York. Mr. Bull stated that he has two freight steamships of practically the same size, one of which is operating under the American flag and the other under the British flag. The total wages of the crew on the American ship per month are $1,470 (£301.9) and on the British ship $897.04 (£184.2). The American

ship is required to carry seven more men than the British ship, and, furthermore, the American ship is never allowed to leave port without a full complement of officers and men, whereas the British ship, in case of desertions, can pick up her crew in various ports as may be convenient. As a matter of interest, Mr. Bull also secured from the German Naval Records a schedule of the pay for a German crew on a similar steamship operating under the German flag. The total wages of the German crew per month are only $483.82 (£99.3), as against $897.04 (£184.2) for the British ship and $1,470 (£301.9) for the American ship. The American captain is paid $175 (£35.9), the British captain $100 (£20.5) and the German captain $79.75 (£16.4) per month. The American chief engineer is paid $150 (£30.8), the British chief engineer $97.20 (£19.9) and the German chief engineer $79.75 (£16.4) per month. It is therefore evident that the American steamship owner is greatly handicapped in competition with either the English or German ship owner in the cost of operating his vessel. Also, the British steamship owner has a considerable handicap to overcome in competition with the German owner. The handicap of the American owner is, however, made still greater by the federal requirements in the matter of outfit, including victualing. This difference was stated by Mr. Bull to be as great as the difference in the wages of the crews. Although the wages paid to German crews are apparently exceptionally low, it should be borne in mind that the German captains, at least, frequently receive, in addition to their regular salary, primage, or a certain percentage of the gross receipts from the freight on the voyage. Taking this into account, the compensation of German and English captains is more nearly equal.

When it comes to the comparative requirements for British and American engineers, as the law now stands, no officer or engineer who has secured a license from a foreign nation is allowed to take the examination for a similar position under the American flag without serving additional time in an American vessel. According to this law, therefore, British and Scotch marine engineers, who have a world-wide reputation as masters of their craft, cannot take charge of an engine in an American ship until they are naturalized, which takes three years, and during that time they must serve in a subordinate position on the American vessel, notwithstanding the fact that they have already spent from six to seven years in England or Scotland to obtain their licenses, while the American engineer is enabled to obtain his license in three years. Furthermore, the British or Scotch marine engineer must serve two or three years in a machine shop, after which he must serve three or four years on board ship, while the American engineer is not obliged to serve any time in a machine shop, and is, therefore, very apt to lack the thorough mechanical training which must necessarily be acquired by the British or Scotch engineer before he can obtain his license, unless, as is frequently the case, the American steamship company gives preference to men who have had machine shop experience when taking new men into their service.

The foregoing instances serve to give some idea of the discrepancies existing in the conditions which govern the operation of steamships under the British, German and American flags. In many cases the American navigation laws are antiquated and work unnecessary hardship on the American ship owner, whereas by changing them to conform more nearly to British or German practice nothing would be sacrificed either to safety or to efficiency, and the unnecessary restrictions would be avoided. It is to be hoped that some action will be taken in this direction in the near future.

New French Destroyers.

Considerable interest attaches to the trials of the new French destroyers on account of the opportunity afforded for a comparison of various types of propelling machinery under practically similar conditions. These destroyers were built primarily for experiment, and a sufficient number were ordered so that three different means of propulsion could be compared, namely: reciprocating engines, turbines and a combination of reciprocating engines and turbines. Moreover, several different types of turbines have been used, one of which at least is making its first appearance in the marine field.

Disregarding the design of the boats from a military point of view, since they are admittedly built principally for experimental purposes, the point which deserves most careful consideration is the comparative results of the different modes of propulsion. Although all of the boats did not prove successful, yet sufficient data is at hand to indicate in a general way the superiority of the reciprocating engine at speeds ranging from 10 to 25 knots. At cruising speed, therefore, the reciprocating engine can be taken as considerably more economical than the turbine drive, and it gives slightly better results than the combined reciprocating engine and turbine. The boats driven by turbines alone show excessive coal consumption up to 25 knots, but above that they give better results. The best results, however, were obtained with one of the boats equipped with a combined reciprocating engine and turbine drive. This showed nearly as good results at cruising speeds as the reciprocating engine-driven boat, and practically as good results as the turbine-driven boats at full power. Furthermore, a speed of .9 knot more was realized with this type. The higher speed, however, is very largely due partly to the design of the hull, which, as explained elsewhere in this issue, involves features not hitherto used in this type of boat.

As a result of the experience gained with these boats, the French Admiralty are now adopting turbines for their destroyers, considering them a necessity in order to gain the high speeds desired.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		May 1.	June 1.
Florida	20,000	20¾	Navy Yard, New York	63.4	66.3
Utah	20,000	20¾	New York Shipbuilding Co.	72.0	76.0
Arkansas	26,000	20½	New York Shipbuilding Co.	24.0	27.6
Wyoming	26,000	20½	Wm. Cramp Sons	19.0	22.5

TORPEDO-BOAT DESTROYERS.

Paulding	742	29½	Bath Iron Works	86.8	89.4
Drayton	742	29½	Bath Iron Works	77.6	82.5
Roe	742	29½	Newp't News Shipbuilding Co.	85.1	88.7
Terry	742	29½	Newp't News Shipbuilding Co.	82.4	86.9
Perkins	742	29½	Fore River Shipbuilding Co.	72.9	79.6
Sterrett	742	29½	Fore River Shipbuilding Co.	71.4	77.1
McCall	742	29½	New York Shipbuilding Co.	66.9	76.5
Burrows	742	29½	New York Shipbuilding Co.	65.6	72.7
Warrington	742	29½	Wm. Cramp & Sons	67.5	68.3
Mayrant	742	29½	Wm. Cramp & Sons	72.6	73.9
Monaghan	742	29½	Newp't News Shipbuilding Co.	18.3	19.9
Trippe	742	29½	Bath Iron Works	31.9	38.8
Walke	742	29½	Fore River Shipbuilding Co.	27.5	32.1
Ammen	742	29½	New York Shipbuilding Co.	30.9	40.4
Patterson	742	29½	Wm Cramp & Sons	17.8	23.0

SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co.	92.7	94.7
Seal	...	..	Newp't News Shipbuilding Co.	48.9	50.1
Carp	...	..	Union Iron Works	47.6	53.5
Barracuda	...	..	Union Iron Works	47.6	53.5
Pickerel	...	..	The Moran Co.	46.4	50.4
Skate	...	..	The Moran Co.	46.1	50.4
Skipjack	...	..	Fore River Shipbuilding Co.	37.6	40.1
Sturgeon	...	..	Fore River Shipbuilding Co.	36.7	38.9
Tuna	...	..	Newp't News Shipbuilding Co.	22.2	26.2
Thrasher	...	..	Wm. Cramp & Sons	4.7	5.7

ENGINEERING SPECIALTIES.

Keuffel & Esser Duplex Slide Rule

An improved form of patented duplex slide rule has been recently placed on the market by the Keuffel & Esser Company, 127 Fulton street, New York. The most recent improvement is the L-shaped end plate, which enables any desired adjustment of the slide to be secured by loosening a screw which passes through the upper portion of one plate, is threaded into the other and fits an elongated hole in the outer section of the slide rule. Loosening the screws at each end of the rule permits the movement of this outer section either in or out to give any desired friction on the slide without disturbing the longitudinal relation of the scales.

FIG. 1.—FRONT VIEW OF NEW ADJUSTABLE DUPLEX SLIDE RULE.

FIG. 2.—BACK VIEW OF THE RULE, SHOWING THE INVERTED SCALES.

The duplex slide rule is so named because it is graduated on both faces, thus giving practically two rules in one. It is formed of three parts, the two outside pieces constituting the body of the rule and the other the slide. The slide being the same thickness as the rule the surfaces of both are flush, and all the graduations are on the exterior, where they may be readily seen and utilized by simply turning the rule over.

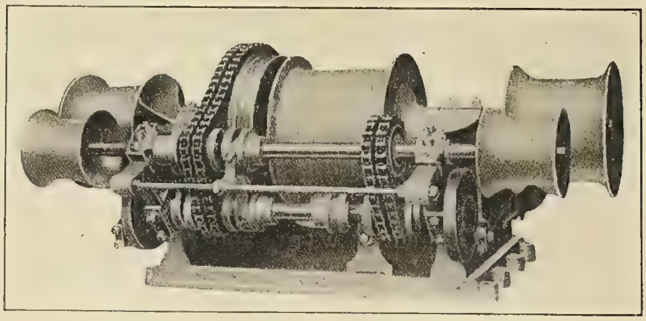
The front face of the duplex slide rule, Fig. 1, is graduated like the familiar Mannheim rule, with all four scales progressing from left to right, while the reverse face, shown in Fig. 2, has the *A* and *D* scales graduated in the customary way, while the *B* and *C* scales are inverted and progress from right to left. The slide in addition to the two inverted scales has the scale of tangents usually found on the back of the slide of an ordinary rule. The indices of the scales on one face are in alinement with those on the other face, and a runner encircling the whole rule enables coinciding points on any scales of either face to be found at once.

The principal advantage of the inverted scales lies in the reduction of the operations required to perform many problems, with a consequent saving in time and increase in accuracy. This is because when setting to quantities on the inverted scales the reciprocals of these values, with respect to the regular scales, are given. Thus the operations of multiplication and division are reversed, and what is a dividing operation with the regular scales becomes a multiplying process with the inverted ones.

These patented duplex slide rules are made in 5, 8, 10, 16 and 20-inch lengths, with and without trigonometrical scales.

David Wilson's Patent Noiseless Winch.

David Wilson's Patent Noiseless Winch Company, 21 Water street, Liverpool, have on the market a winch which is operated by sprockets and chains. The chains operate on three-fourths of the main barrel wheel, thus distributing the weight nearly all over this wheel instead of working with one tooth, as in the ordinary winch. The chain being double catches on ten teeth

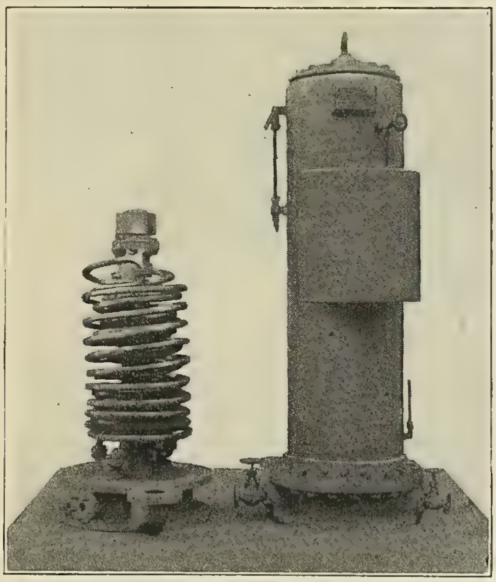


on the smallest pinion of the intermediate shaft, which is fitted with adjustable bearings to regulate the chains. The chains are of the roller type, made of the best steel, case hardened, and tested to 12 tons each. It is claimed that the wear in this type of chain is on the whole length of the pin, and that no wear whatever takes place on the links. It is also claimed that as there is a free motion and very little friction this winch will lift as much weight at 40 pounds pressure as the usual winch will lift at 60 pounds pressure, and that at the same time it works quietly. This improvement can also be applied to the ordinary type of steam winch, which can be converted without removing the winch from the ship's deck.

The North Eastern Patent Feed Cleaner and Heater.

This apparatus is designed for the effectual removal of grease, fatty acids and air from feed water by means of centrifugal action without straining the pumps or clogging up the

apparatus. The illustration shows the heater both with the outer casing removed and with the casing in place. The feed water enters at the bottom and rises through a central column, escaping at the top of the column through a fixed turbine. The water is drawn off from the bottom of the heater. Steam circulates through the coils, and the working level of the water



in the heater is maintained by the compression of air in the heater as the heater is filled. A scum valve is provided, discharging into a settling tank, whence it overflows to the hot well. This feed cleaner and heater is manufactured by the North Eastern Marine Engineering Company, Ltd., Sunderland.

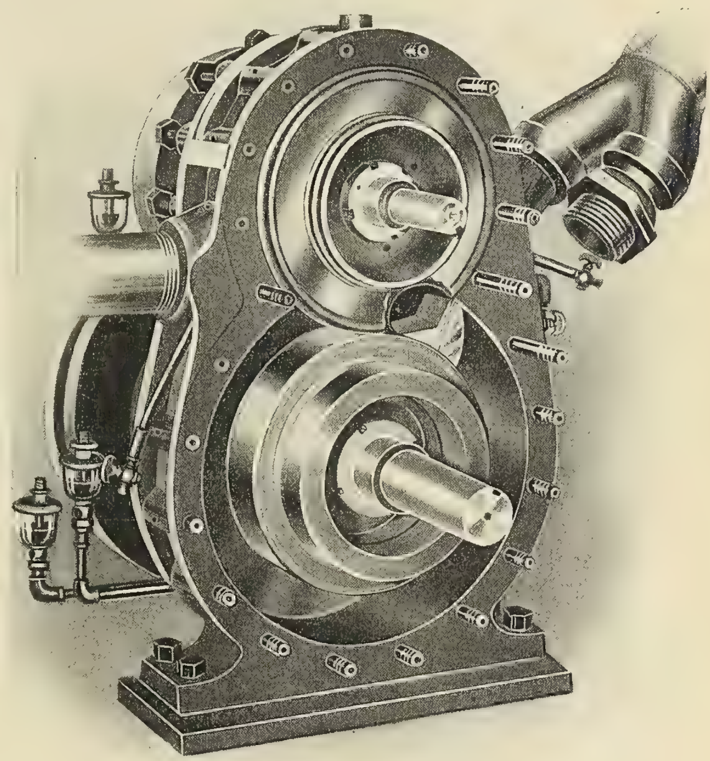
The Herrick Balanced Rotary Engine.

After a long and careful study, Mr. G. P. Herrick, 74 Broadway, New York, has invented a rotary engine which it is claimed fulfills all the requirements of a commercial engine and shows remarkable economy and reliability. The engine differs from all other rotary engines, in that by the use of a newly-discovered counterbalanced bearing it overcomes completely and automatically the friction on its main bearing, due to the radial steam loads. This balancing is accomplished by introducing into a series of stationary balancing chambers a film of steam 1/32 inch thick. These balancing chambers are successively and automatically connected with the cylinder by passages in the rotor. As the piston revolves and the area of the rotor exposed to cylinder pressure increases the counterbalancing area, through the admission of steam through the successive chambers, is equally increased. Thus the primary load and the balancing load are kept equal. As the steam in the cylinder is reduced in pressure through expansion, the pressure in the balancing chambers, which are continuously in communication with the cylinder, is correspondingly reduced.

As shown in the illustration, the engine is a simple steam engine, in which two rotors—an upper rotor to control steam and act as a cylinder abutment, and a lower, a piston rotor—are superposed in rolling contact. The upper rotor contains a recess, which serves as a steam inlet and allows the piston on the lower rotor to pass. The synchronous movement of the rotors is maintained by means of timing gears. Plugs, containing the balancing chambers and a check, are inserted between the rotor and the main bearing. The only points of moving contact in the engine are at the bearings, the rolling contact and the checks in the balancing plug. Power is developed directly along the shaft of the lower rotor.

Steam, admitted to the cylinder through the recess in the upper rotor, both causes the piston to revolve in a continuous circular path and also by exerting counterbalancing pressure in the balancing chambers overcomes through the stroke the radial loads that the cylinder pressure would otherwise exert on the main shaft. The Herrick engine, like the reciprocating type, uses static pressure behind a piston. Like the turbine, it rotates its shaft directly, but uses a single piston instead of many blades on its rotor. It thus combines the steam cycle of the reciprocating engine with the mechanical operation of the turbine.

Steam is admitted to the cylinder chamber behind the piston blade shortly after the blade has left the recess in the upper drum by means of a circular valve. After the required amount of steam has been admitted, the opening in the valve ceases to register with the opening in the cylinder casing, and the steam supply, being cut off, the steam in the cylinder expands against the piston blade rotating the lower drum and the main shaft and also the upper drum and the valve, exhausting after approximately three-quarters of the revolution and just before the piston blade re-enters the recess in the upper drum to pass the abutment.



The casing which forms the cylinder, and incases the drums and rotors, consists of a center body and two side plates. To the side plates, concentric with the upper and lower shafts, are fastened plugs, which enter the annular spaces on each side of the central webs of the drum and between their hubs and annular rings formed on their circumference. These plugs are provided with labyrinth packing and bearings for their respective shafts. They are also provided with chambers on the periphery or outer cylindrical surface of their annular extensions which enter the drums. Each of these chambers at the proper time communicates with the cylinder radially opposite to itself, and is thus provided with steam at the pressure in the cylinder at that point. It is this steam in the chambers which acts as a pressure film and accomplishes the balancing of the radial loads previously mentioned.

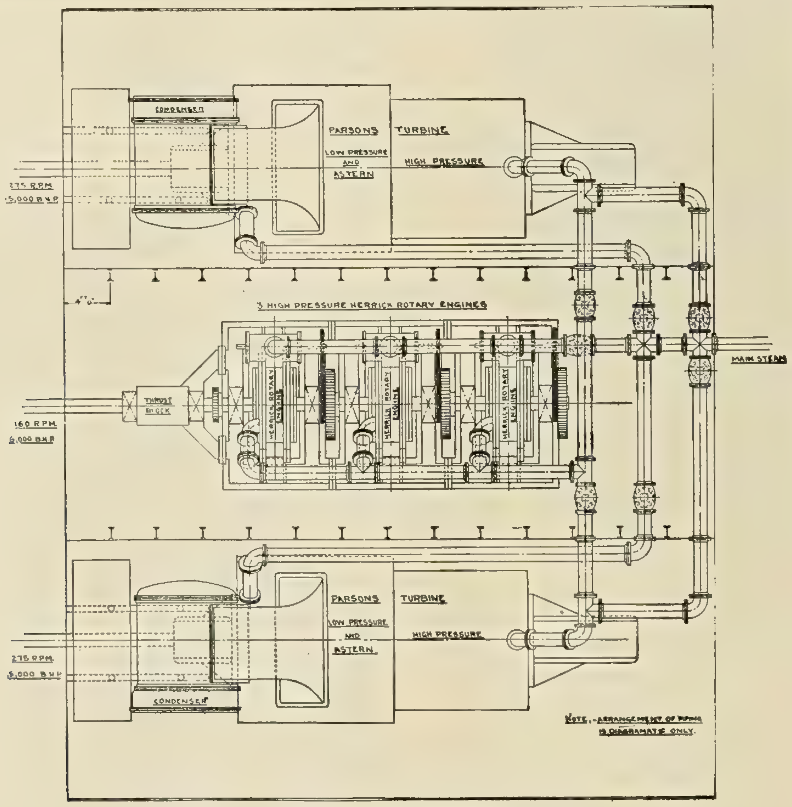
The abutment cylinder is packed by a check piece, which prevents steam from passing upward around the drum while the line contact of the surface of this abutment, where rolling on the drum of the rotor minimizes loss in this direction.

The piston packing is of an approximate contact character. The upper face has a check or tongue piece which slides in a groove from the side and which is limited in its motion in an axial plane by shoulders properly fitted and provided for. Centrifugal force tends to keep this piece out as far as its adjustment permits; but this, if desired, can be augmented by spiral springs in circular recesses beneath the packing strip. The sides of the piston are packed somewhat similarly, but the strips are there necessarily held up by springs as described above. Thus pieces extend radially the full length of the piston and cover the ends of the packing strip on the upper or end face. In all this piston packing actual contact with the cylinder is intentionally avoided, yet without sacrificing seriously in leakage. Where the radial engine is used as the high-pressure unit in combination with low-pressure turbines, the leakage, of course, would be used in the turbine at good economy, but even where there is no opportunity to use the leakage it appears from tests that the energy lost in this way is fairly compensated for by the lack of that piston friction which is usual in reciprocating engines of equal powers.

Tests made on a 20-horsepower engine of this type by Prof. Frederick L. Pryor, of the Stevens Institute of Technology, show the following important features:

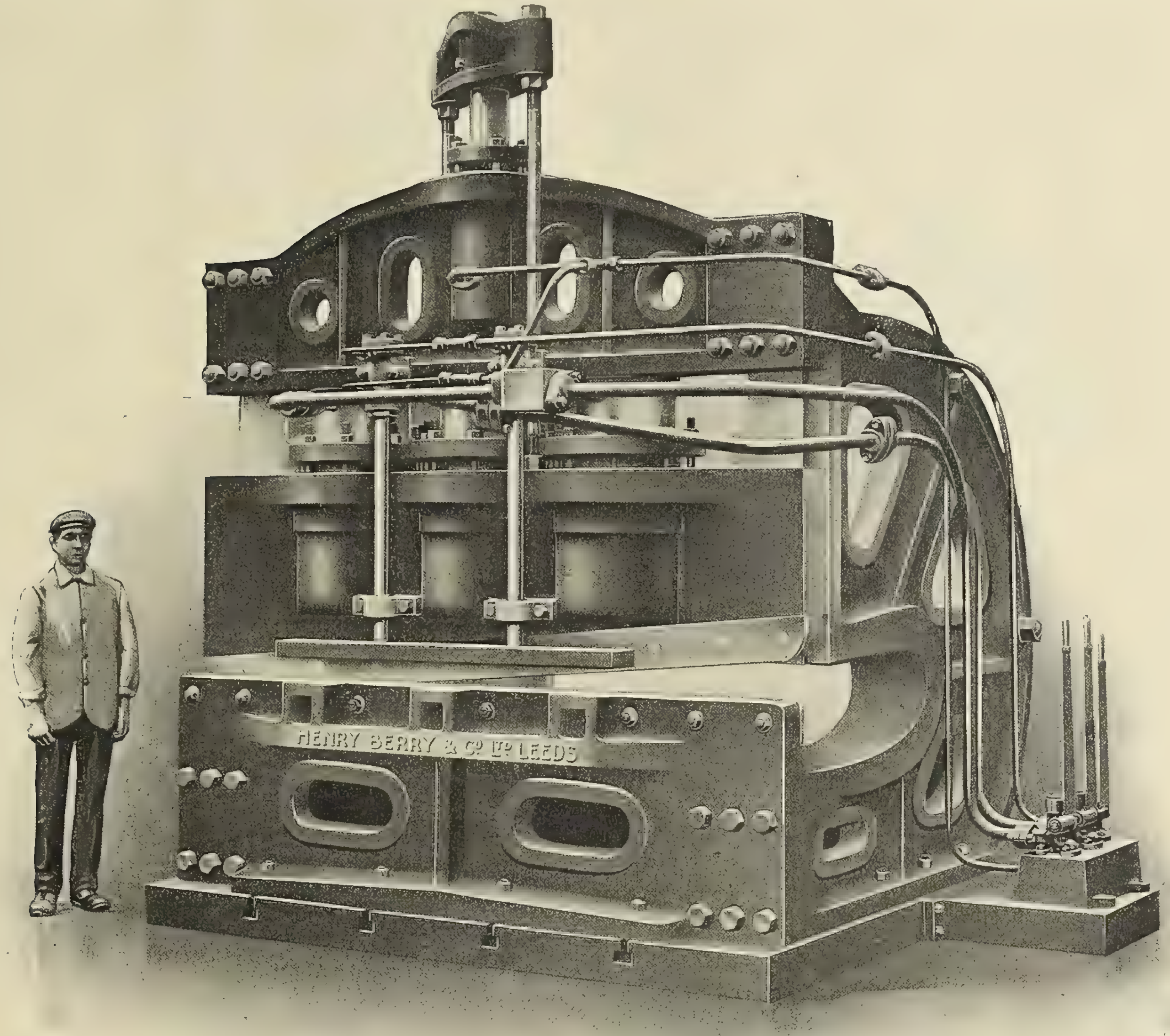
1. The engine ran 1,685 hours out of 2,664 hours.
2. It operated for 66 days of 17 hours each.
3. It operated for 18 days of 24 hours each.
4. It operated consecutively for 149 hours.
5. Only two stops were absolutely necessary, due to trouble with the engine, and these troubles were not serious.
6. The total steam consumption of the engine was not increased, due to the endurance run.
7. The decrease in horsepower and increase in steam consumption per brake-horsepower-hour can be explained by alterations made in the bearings of the engine.
8. The steam consumption of the engine per brake-horsepower is exceedingly good for the size of the engine, and it is equivalent to the steam consumption in many engines of equal power now on the market.
9. The space occupied, the weight of the engine and economy in the engine compared with other engines on the market indicate that the inventors now have a commercial engine.

The steam consumption per brake-horsepower under the best conditions during these tests was 50.7 pounds. On these tests the steam pressure varied from 105.3 to 145 pounds per square inch, the revolutions from 1,000 to 1,012 per minute. The engine ran non-condensing most of the time, and part of the time exhausted into a vacuum of 18.4 inches of mercury.



PROPOSED ARRANGEMENT OF 36,000 B.H.P. MARINE PROPELLING INSTALLATION
3 HERRICK ROTARY ENGINES IN COMBINATION WITH 2 OF PARSON'S STEAM TURBINES
DATE— 18-APRIL-1910

The engine is peculiarly suited to marine work on account of its small size and weight per horsepower, its low first cost and low cost of maintenance. It is estimated that a 100-horsepower engine will weigh only 4,000 pounds, and as the engine operates with a direct drive at all the advantageous speeds between those of the reciprocating engine and the turbine, its adaptability for marine propulsion is, therefore, evident. It can be easily reversed, eliminates vibration, and can be used for superheated steam and high pressures, and, if desired, can be adapted for compounding. Perhaps the most interesting and valuable possibility of this engine, provided the results obtained with a small engine are maintained when the engine is developed into larger sizes, is its use as the high-pressure stage in connection with low-pressure turbines. One of the illustrations shows a proposed installation of this sort, where a modern battleship requiring about 36,000 horsepower is driven by triple screws. The two wing screws are driven by turbines developing 15,000 horsepower each, and the center screw by a Herrick rotary engine of about 6,000 horsepower. For this combination it is estimated that 10.8 pounds of water will be required per brake-horsepower.



Large Hydraulic Plate Shears.

The illustration shows a hydraulic plate shear for cutting hard steel plates, two of which were recently supplied to the Italian government by Messrs. Henry Berry & Company, Ltd., Leeds, for use in the dockyards. The machine has all the framing of cast steel, and is mounted on a massive cast iron baseplate; it will cross-cut hard steel plates up to 6 feet 7 inches wide by 1¼ inches thick and of any length. There are three main cylinders, each fitted with turned and polished rams, so arranged that one, two or three rams may be used as desired, thus ensuring considerable economy in the use of pressure water when shearing thin plates. The main slide is of cast steel, carrying the moving shear blade, and is guided by carefully machined and fitted slides on the side frame. The latter are bolted to the baseplate and held rigidly in position by the front shear frame, the crosshead and heavy stays at the rear of the machine. A drawback cylinder, cast in the crosshead, is fitted with a turned and polished ram working through a gunmetal gland with leather packing, which lifts up the shearing slide after making a cut; and two small vice rams are placed at the front of this slide to hold down the plate being sheared.

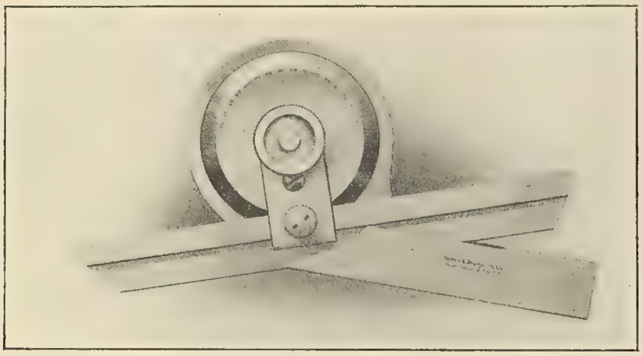
All of the rams for the different movements are controlled by one man from a set of working valves of Berry's Patent B. B. type, which are carried on a stand in a convenient position.

The machines are to work with an accumulator pressure of 1,500 pounds per square inch, and the first one was recently tested at the makers' works in the presence of an inspector for the Italian government by shearing plates 6 feet 7 inches long by 1½ inches thick.

Improved Bevel Protractor.

The improved bevel protractor shown herewith, which was recently put on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I., is an accurate and inexpensive tool for laying out or establishing angles. Not only is it useful to draftsmen but it is also of great service to mechanics. In design the tool is very simple, and is very similar to the improved universal bevel protractor made by the same company. The main point of difference between the two tools is the fact that there is no vernier on the bevel protractor, and so the measurements cannot be made to such a degree of fineness. To facilitate use of the tool one side of the protractor is flat, and this allows the tool to be laid flat on the paper or work, a decided advantage that users of the protractor will appreciate. The dial is graduated in degrees, and these graduations extend over an arc of 180 degrees, reading

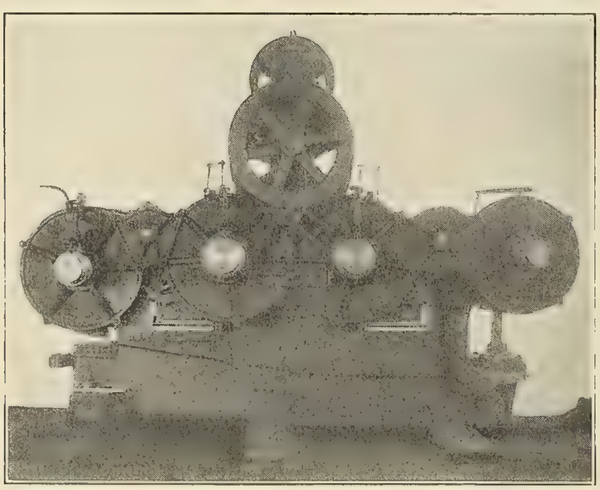
from zero to 90 degrees from each extremity of the arc. Especial care is taken with these graduations to have them accurate. The large central stud upon which the dial of the protractor turns is hardened in order to eliminate as much wear as possible. When the protractor is set and the nut tightened it clamps the dial rigidly in position so that there is no danger of slip. The blade of the protractor is free to move backward



and forward for its entire length independently of the dial, and this adapts it unusually well for work where other protractors cannot be used. It is clamped independently of the dial and is rigidly held in place. Great care has been taken in cutting the grooves, etc., so that there is very little chance for dust to accumulate and cause inaccuracies in the measurements.

Universal Shear for Channels, Angles, and Plates.

The need in ship yards for a machine to cut square or mitred the various channels and angles required for ship building purposes has been met by the machine shown herewith. While especially built for the Marine Department of the Maryland Steel Company, Sparrows Point, Maryland, this machine is intended for any class of iron workers. It is provided with a coping attachment at one end of the ma-



chine; a plate shear at the other; and two angle shears, operating at an angle of 45 inches in the center of the frame. The latter have a capacity for cutting up to 15 inches by ¾ inch channels, and 6 inches by 6 inches by 1 inch or 8 inches by 8 inches by ¾-inch angles. The plate shear has a capacity for 1 inch material. Each shear is controlled by its own clutch, and the machine may be operated by different groups of men all working at the same time, and without interfering with each other. The frame, plunger, pendulums, clutches, and all parts subject to shock are made of semi-steel castings. Hammered steel shafts containing .4 to .5 carbon are used for the shafts, and the question of lubrication has been given special consideration. The gears are provided with long sleeve hubs, and the covers which protect the gears are bored to receive them. The gears in turn support the shafts, which have bearing surfaces throughout their entire length. A patent stop motion is used, which automatically throws out the clutch on each shear when it reaches its highest point. For the coping attachment, which may also be used for punching, the stop mechanism is adjustable so that the plunger may be stopped in any point of its down stroke. It will be noted by the cut that the plates for supporting the angles or channels while being cut are so placed that they are out of the way of plates while being sheared as the latter pass under them. The machine in question weighs about 23 tons. It is driven by a 25 horsepower electric motor, and is manufacturered by the Covington Machine Company, Covington, Virginia and New York.

TECHNICAL PUBLICATIONS.

Corrosion and Preservation of Iron and Steel. By Allerton S. Cushman and Henry A. Gardner. Size, 6 by 9 inches. Pages, 373. Figures, 68. New York, 1910: McGraw-Hill Book Company. Price, $4 net.

This book was written mainly to elucidate the electrolytic theory of corrosion and a considerable portion of it is taken up with the description of results of the researches of one of the authors who has been working in a government laboratory along these lines. The book is not limited to this, however, as the authors have endeavored to include or mention the results of all recent investigations of original researches touching on the subject which have appeared up to the time the book went to press.

Electric Power Plants. By Thomas Edward Murray. Size, 6 by 9¼ inches. Pages, 337. Figures, 152. New York, 1910: The New York Edison Company.

This book is designed to exhibit the engineering details of certain modern electric light and power plants which represent the most advanced design and construction. They comprise the largest stations of the New York Edison Company in the Borough of Manhattan, the new power stations of the Brooklyn Rapid Transit Company, the Gold Street Station of the Kings County Electric Light & Power Company, two stations in smaller cities, one industrial power plant and one hydro-electric plant. The author was the designer of these plants, supervised their construction, and, in the book, he has confined himself to the exposition of facts and of data valuable for the purposes of comparison to the electrical engineer and power station builder.

Sailing Ships and Their Story. By E. Keble Chatterton. Size, 9½ by 7 inches. Pages, 362. Illustrations, 130. Plans, 9. London, 1910: Sidgwick & Jackson. Price, 16/– net.

The book is a history of the development of sailing ships from the earliest times to the present day. Its author is a well-known London journalist who has made yachting his chief hobby. It is not a highly technical work, but was written primarily for the general reader. It will, however, be found a useful reference book, dealing with the sailing ships of different historical periods.

The divisions of the book are very convenient. The first chapter covers early Egyptian ships from about 6000 B. C., followed by an interesting section covering 40 pages on the ancient ships of Phœnicia, Greece and Rome. Early ships of Northern Europe are dealt with in a chapter giving some excellent illustrations of Viking vessels. The development of the sailing ship from the eighth century to the year 1485 occu-

pies some 40 pages; the chapters on the historical periods from Henry VII. to Elizabeth (1485-1603) and from James I. to the close of the eighteenth century bring the subject closer to our own time; the sailing ship in the nineteenth and twentieth century is followed by an excellently written dissertation on the fore and aft rig and its developments; coasters, fishing boats, yachts, etc.

The book is written with a good deal of literary ability, and Mr. Chatterton has gone to considerable pains in securing his material and illustrations.

The Ramparts of Empire. By Frank Fox. Size, 5 by 7½ inches. Pages, 271. Illustrations, 17, full-page, in color. London, 1910: A. & C. Black. Price, 5/– net.

The sub-title of this work is "A View of the Navy from an Imperial Standpoint," and Mr. Fox, who is a writer of Colonial repute, has given an enthusiastic sketch of the navy as he sees it, tracing it from its rise to its present status, and then dealing in two chapters with the new era which has recently begun, viz.: an imperial navy; these two latter sections are divided into "The Subsidy Era" and the "Era of Co-operation."

We understand that the British Admiralty allowed the author special facilities, so that he might obtain an adequate impression of the navy. The book avoids technicalities, and simply aims at giving a picturesque account of England's first line of defense. It is thoroughly up-to-date; an appendix gives details of the naval estimates for 1910-1911.

Told in the Dog Watches. By Frank T. Bullen, F. R. G. S. Size, 5 by 7½ inches. Pages, 332. Illustrations, 2. London, 1910: Smith, Elder & Company. Price, 6/–.

A new volume, by the well-known author of the "Cruise of the *Cachalot*," has appeared with the above title. Some 35 sketches and essays on marine subjects are included, which are quite up to the delightful standard of Mr. Bullen's previous works. It is generally known that the author was formerly an errand boy in London, and went to sea in 1869, where he served in varying capacities up to and including chief mate in all parts of the world. Mr. Bullen is possessed of remarkable gifts, and has turned these to great service in connection with his earlier experiences. We notice that he has no less than twenty-six books to his credit.

The sketches included in this new work deal with a variety of subjects, both grave and gay. Among those of special interest are "Romance of Wreck Raising," "The Sea Changes of Fifty Years," "The Making of a Merchant Service Officer," "Romance of Whaling," and "Life on Board a Battleship." The book constitutes a delightful volume for the leisure hour, and we can recommend it without reserve.

The Navy of Venice. By Alethea Wiel. Size, 5½ by 9 inches. Pages 370. Numerous illustrations. London, 1910: John Murray, Albemarle street, W. Price, 15/–.

The student of marine subjects will find this book particularly interesting, as it deals with the naval history of a city whose rise and fall have given the opportunity to many a novelist and poet. The authoress is the Hon. Alethea Jane Wiel Lawley, the daughter of Baron Wenlock, and she is specially qualified by reason of her long residence and studies in Venice to deal with a subject which up to now has been ignored, or only dealt with in conjunction with other Italian ports.

The present work deals entirely with the Venetian navy in war and commerce during the reign of the Republic. The period from 452 to 943 is covered in the first chapter, which deals with the early Venetians on land and sea. The picturesque rite of the espousal of the head of the Republic with the sea is well described in an interesting way in the section upon "Trade and Pageant and War" (959-1085). A descriptive chapter on the various types of warships, including galleys, quinqueremes, quadriremes and galleons is followed by a section on the Crusades (1097-1130). The chapter which is probably the most interesting one to our readers is that which deals with the arsenal and dockyards, "where the force which generated the power and wealth of Venice lay." Historical chapters follow upon Venice and Constantinople, the Fourth Crusade; "blind old Errico Dandolo," who refused the crown of Byzantium; Venice and Genoa; the War of Chioggia; Venice and the Turks. In this latter chapter Mrs. Wiel hints at the discovery of America having much to do with the decay of the glory of Venice. The last chapters are upon the war with Cyprus (1521-1570), Lepanto (1571), and the War of Candia (1635-1694). The concluding section gives a retrospect of the commerce of Venice—its beginning and decay.

The illustrations are excellent, and well depict the various classes of vessels at different periods; some of these are from models in the arsenal, and others from pictures. Mrs. Wiel aptly says in her preface, "That no work dealing exclusively with the subject has yet been written, is a strange and curious fact—that it should be handled for the first time by a woman, and a foreigner, is stranger still." The book is marked by the literary skill of a clever authoress.

COMMUNICATION.

Development of Battleships.

EDITOR INTERNATIONAL MARINE ENGINEERING:

I read with much interest the description in your May issue of the two battleships recently contracted for by Argentina. They certainly are to be remarkable ships, in that they set a standard which no great nation has yet reached. No plans have been proposed by the British Admiralty, so fas as I have learned, calling for ships equal to the Argentina ships, and I have not learned that Germany has undertaken to build ships equal to them. From what little the cable reports contain regarding the new naval programme of America, it is evident that that government plans to build two battleships inferior to those which are under construction for Argentina.

Why is it that naval authorities lag behind so much in the development of battleships? E. C.

London, W.

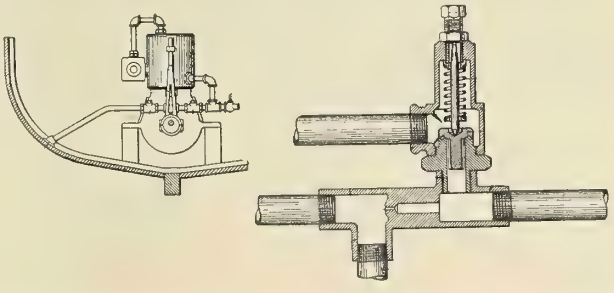
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

952,294. PUMPING APPARATUS. SOLOMON E. AARON, OF CHARLESTOWN, MASS.

Claim 6.—A pumping apparatus having, in combination, an ejector provided with an inlet for the actuating stream, a suction inlet for the



entrained stream, an outlet for the combined actuating and entrained streams, and an outlet between said first and second mentioned inlets; a relief valve connected to said second mentioned outlet, and means

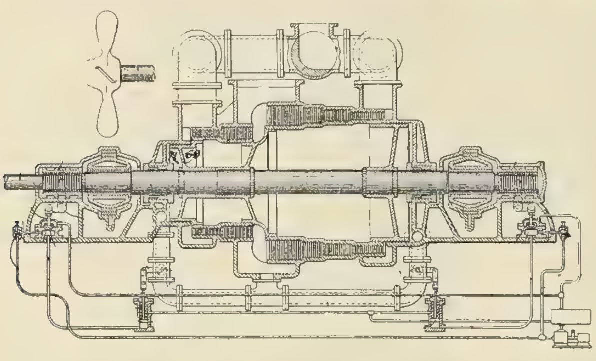
whereby fluid may be supplied to said first mentioned inlet under pressure. Six claims.

951,360. DREDGING MACHINE. NAPOLEON B. BROWARD, OF JACKSONVILLE, FLA.

Claim 1.—In a dredge boat adapted to swing at the bow from side to side of the channel cut, to operate on the whole surface at the end of the cut, a hollow cylinder rotatable in fixed bearings on the forward end of the boat and arranged with its bearings in a substantially vertical line said cylinder having openings into the interior of the cylinder, and exterior cutters for removing the soil and directing it to the interior, means for rotating the said cylinder, and means for exhausting the soil and water. Five claims.

953,530. END-THRUST APPARATUS FOR FLUID-PRESSURE TURBINES. FRANCIS HODGKINSON, OF EDGEWOOD PARK, PA., ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, A CORPORATION OF PENNSYLVANIA.

Claim 1.—In combination with an elastic fluid turbine, a piston carried at one end of its rotor, a chamber behind said piston into which steam passes from the inlet end of the turbine, a passage between said chamber



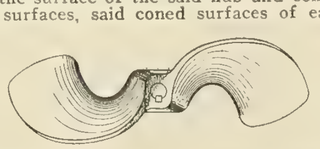
and the turbine exhaust port, a valve in said passage, a fluid pressure actuated device for operating said valve and means dependent upon the rotor end thrust for controlling said device. Eleven claims.

953,283. MEANS FOR EXPELLING THE GAS-ENGINE EXHAUST OF SUBMARINE BOATS. LUDWIG NOÉ, OF KIEL, GERMANY, ASSIGNOR TO FRIED. KRUPP AKTIENGESELLSCHAFT GERMANIAWERFT, OF KIEL-GAARTEN, GERMANY.

Claim 2.—A process of expelling the exhaust gases of gas-engines during the submarine travel of diving boats, consisting in storing the gases and expelling them at great and irregular intervals of time. Three claims.

954,053. PROPELLER. HENRY F. SHAW, OF BOSTON, MASS.

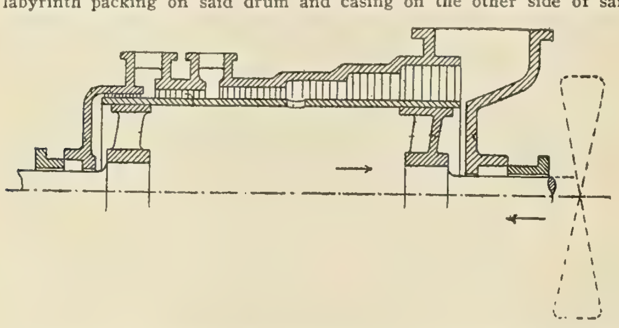
Claim.—A propeller having a coned hub larger on its fore end than on its aft end, and blades whose working surfaces leave the hub as a surface tangent to the surface of the said hub and continuing therefrom constituting coned surfaces, said coned surfaces of each blade being a



part of the surface of a cone the axis of which is inclined to the axis of rotation of the propeller as described; the aft boundary lines, that is, the aft edge lines of the propeller blades, lie approximately in the surface of a cone the axis of which coincides with that of the rotation of the propeller. One claim.

954,212. BALANCING MEANS FOR TURBINES. CARL ROTH, OF ZEHLENDORF, NEAR BERLIN, GERMANY.

Claim 1.—In combination, a propeller shaft, a turbine drum on said shaft, a casing around said drum, a steam inlet and an exhaust outlet on said casing, blading on said drum and casing on one side of said inlet, a labyrinth packing on said drum and casing on the other side of said



inlet, a closed disk within said turbine drum, an overload inlet on said casing, a connection from an intermediate point later in the expansion of the steam than said overload inlet, and opening to the interior of the drum on one side of said closed disk and on the opposite side of the labyrinth packing to the steam inlet, said disk being on its other side subjected to the pressure of the exhaust. Two claims.

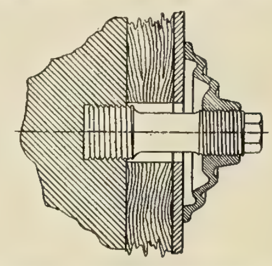
953,694. LAUNCHING APPARATUS. CHARLES HUNT, OF NEW YORK, N. Y., ASSIGNOR OF ONE-FOURTH TO JASON ROGERS, OF ESSEX FALLS, N. J.

Claim 1.—A launching for boats, comprising a support for the life boat, davits mounted to turn, tackles held on the said davits and connected with the said life boat, a manually controlled driving shaft, and mechanism for actuating the said support, the davits and the tackle from the said driving shaft. Nine claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

3,688. MEANS FOR SECURING ARMOR PLATES TO WARSHIPS. G. RUSO, ROME, ITALY.

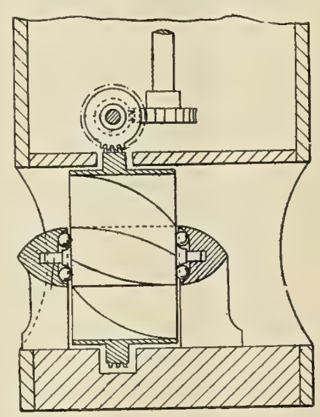
This invention has for its object to provide differential screw-bolts with an elastic cup-shaped washer for the purpose of lessening or obviating injury to the bolt under the jarring effect of a blow upon the armor and of preventing parts of a broken bolt being violently projected into the interior of the ship, and avoiding the use of a special



protecting cap, intermediary washers of rubber or other perishable material, while reducing the weight and space ordinarily required for the usual fastening means. Accordingly differential screw-bolts are used in conjunction with the cup-shaped washer forming the nut of the bolt.

4,811. SHIP'S LOGS. W. C. FORBES AND J. STARNES, LONDON.

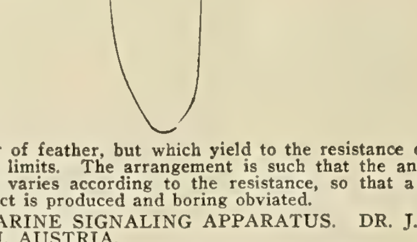
According to this invention, the rotator or fan for actuating the indicating mechanism through a shaft is mounted on a horizontal axis in the end of a housable cylinder and is extended through a sea-valve into the



dead water, which thus operates the rotation. This construction gives reliable records at low speeds. Modified forms of rotators or fans are described.

7,084. SCREW PROPELLERS. A. G. TAYLOR, LONDON.

According to this invention, the blades are each formed with a spindle end in alignment with the forward edge of the blades and projecting into a hollow boss. Here the spindles have cams which are acted upon by springs which may tend to keep the blades in a normal position of



steep pitch, or of feather, but which yield to the resistance of the water within certain limits. The arrangement is such that the angle assumed by the blades varies according to the resistance, so that a more equal propelling effect is produced and boring obviated.

10,083. MARINE SIGNALING APPARATUS. DR. J. SCHIESSLER, BADEN, AUSTRIA.

The main object is to provide apparatus for picking up syntonized sound signals under water and by which the distance of a source of sound or of a point remote from the observer can be readily determined according to the principle which consists in measuring the time between the arrival of light waves, i. e., electrical waves, and sound waves sent out simultaneously, after hich the distance of this source or point from the observer is determined by a simple calculation of the time measured, multiplied by the velocity of sound. To this end the apparatus comprises five circuits: I. The microphone circuit. II. The circuit of the telephone relay. III. The inductive telephone circuit. IV. The circuit of the electrical chronometer, and V. The circuit of the hearing receiver of a wireless system.

International Marine Engineering

AUGUST, 1910.

ITALIAN ARMORED CRUISER S. GIORGIO.

BY DAGNINO ATTILIO.

This cruiser is the third of four first-class armored cruisers building for the Italian navy. She was launched from the shipyard of Castello mare di Stabia, near Naples, and engined by Messrs. Ansaldo Armstrong & Company's Engine Works at Sampierdareno. The ship has the following dimensions:

	Feet.
Length over all	461
Length between perpendiculars	427
Extreme beam	69
Depth	39.9
Mean draft	23.6
Maximum draft	24.4
Metacentric height	3.94
Normal displacement in tons	10,118

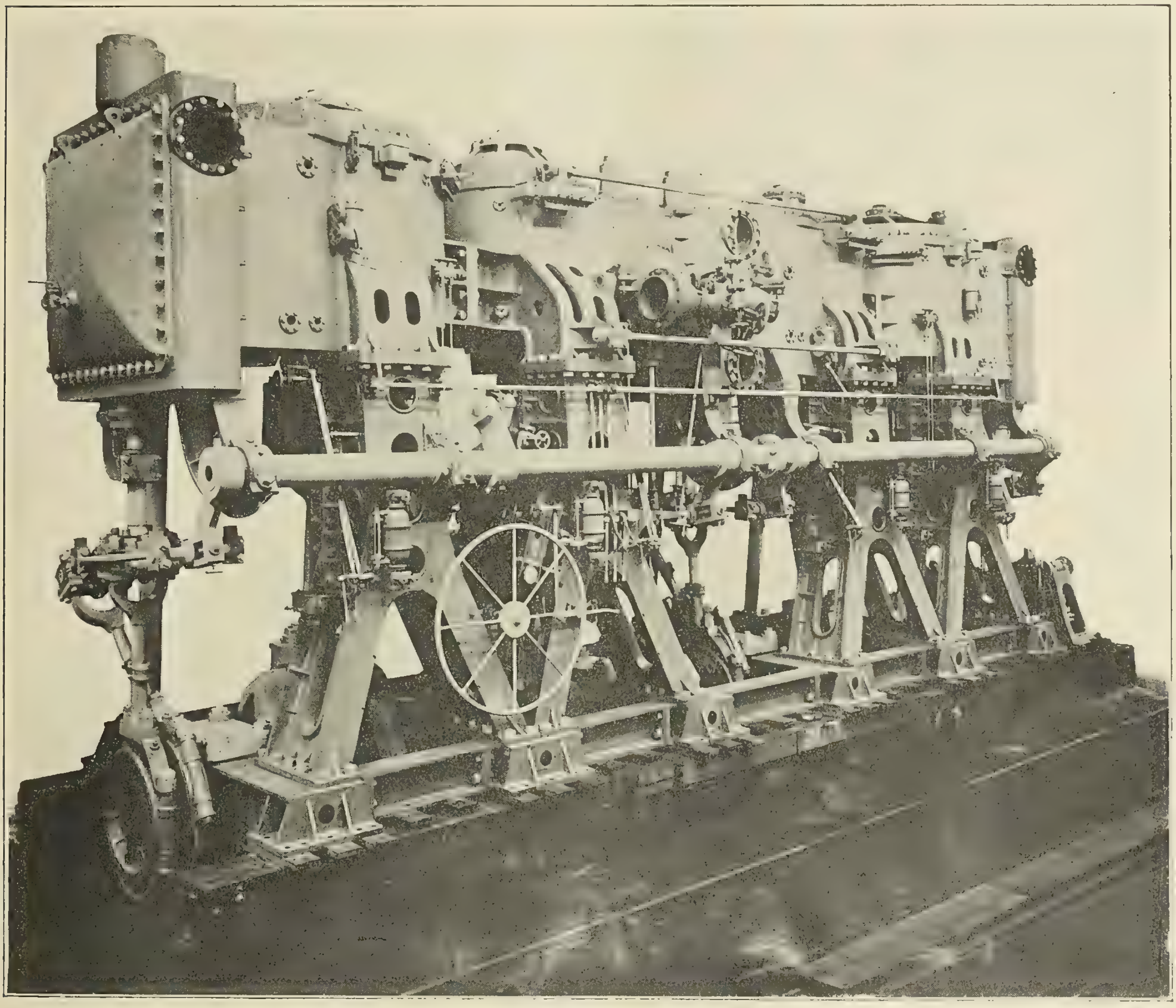


FIG. 1.—STARBOARD ENGINE OF THE ITALIAN ARMORED CRUISER S. GIORGIO. CYLINDER DIAMETERS, 34⅝-56-64⅛-64⅛ INCHES; STROKE, 39⅜ INCHES.

There is a complete armor belt running from stem to stern, with a width of 7 feet 3 inches, of which 4 feet 11 inches is

below the waterline. The maximum thickness is 7.87 inches, decreased to 3.16 inches at stem and stern. The protective deck has a thickness of 1½ inches.

The battery is an extremely powerful one, including four 10-inch guns, 45 calibers long, mounted in pairs in turrets forward and aft, with an arc of fire of 260 degrees. The height of these guns above the water is 24 feet 3 inches. There are eight 7.5-inch guns, 45 calibers long, in pairs in four turrets at the corners of the superstructure. These have an altitude above the water of 22 feet 2 inches. They have a range of fire of 160 degrees. The secondary battery includes sixteen 3-inch guns, eight 3-pounders and four Maxims. There are three 18-inch torpedo tubes, all submerged, two being located just aft the ram, while the other one is just above the rudder. All of the artillery is of the latest Vickers type, and was made in Barrow-in-Furness.

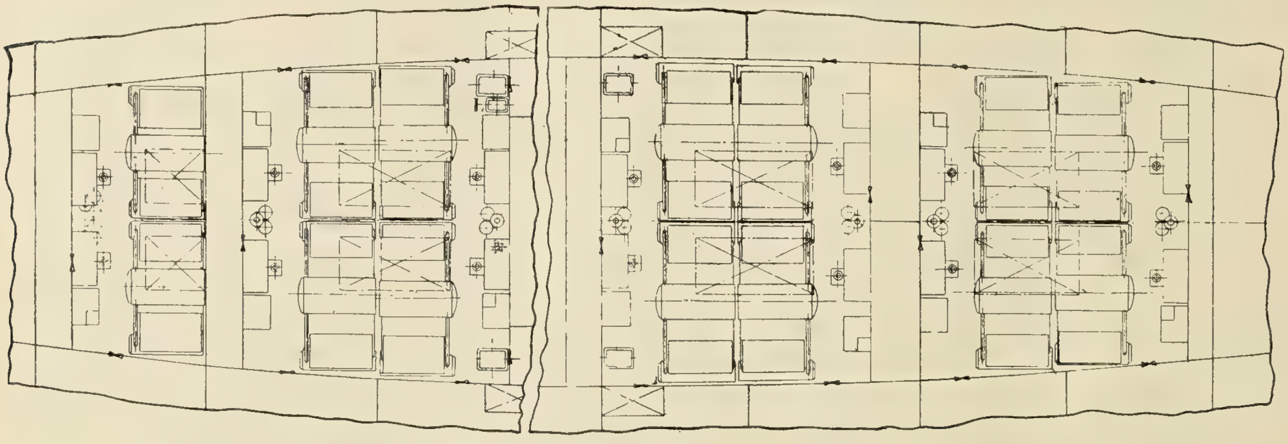


FIG. 2.—BOILER ARRANGEMENT OF THE S. GIORGIO.

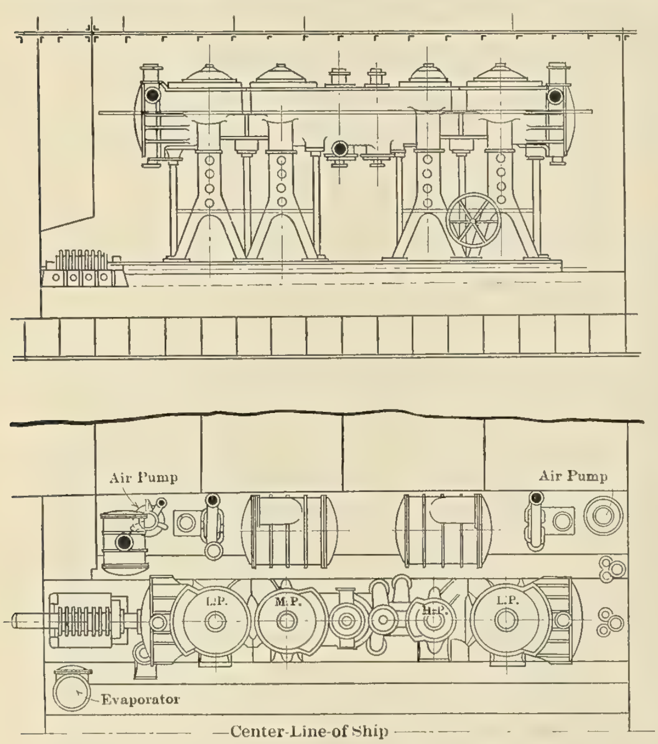


FIG. 3.—ENGINE ROOM ARRANGEMENT.

This ship is propelled by twin screws, actuated by triple-expansion engines, with a designed horsepower of 18,000 under forced draft, and at 145 revolutions per minute. In the recent trial trip of six hours a speed of 23 knots was obtained, developing 19,000 indicated horsepower, with a corresponding speed of 20 knots at 15,000 horsepower and natural draft.

The two main engines are four-cylinder triple-expansion of the vertical inverted type, balanced according to the Yarrow, Schlick, Tweedy system. They are placed in two separate compartments, with a central bulkhead between. The boiler pressure is 240 pounds per square inch.

The diameters of the high-pressure, intermediate and each of the two low-pressure cylinders are, respectively, 34⅝ inches, 56 inches and 64⅛ inches. The stroke is 39⅜ inches.

The high-pressure and intermediate-pressure cylinders have piston valves of an average diameter of 20 inches and 30 inches, respectively, while the low-pressure cylinders have double-ported slide valves, with compensators at the back. Simple balance cylinders are fitted, both to the piston and to the slide valves.

The valve gear is of the Stephenson link-motion type. The reversing engine is of the all-round type. The pistons, cylinder covers, steam chest covers, bed-plate and columns are of cast steel, the pillars being of wrought steel.

The arrangement of cylinders from forward aft is: Low-pressure, high-pressure, intermediate-pressure, low-pressure. The distance between the forward low-pressure cylinder and the high-pressure cylinder is 43¼ inches; the same distance is between the intermediate and the last low-pressure cylinder, while the distance between the high and the intermediate is 150 inches.

The crank-shafts are of steel and hollow. Each is composed of two parts, and there are two cranks on each part. Each crank-shaft has six main bearings, four of which are 24 7/16 inches and two 29 inches in length. The outside and inside diameter of the crank-shafts in the bearings are, respectively, 16⅛ inches and 8 inches. The diameter of crank-pins is 16¾ inches, and their length 23¼ inches. The turning wheel is fixed on the coupling at the after end of the engine.

The length of the connecting rods is 86⅝ inches, and the minimum diameter is 8⅝ inches. The outside diameter of the piston rods is 8⅝ inches. The outside diameter of the pillars is 7⅛ inches. The main steam pipe is 12⅜ inches in diameter, and the diameter of the two pipes between the high and intermediate-pressure cylinders is 13⅜ inches. Four 13⅜-inch pipes bring steam from the intermediate-pressure cylinder to the two low-pressure cylinders.

The diameter of thrust shaft is 16⅛ inches outside and 8 inches inside. Each thrust shaft has eight collars, with a thrust surface of 15½ square feet. The screw shafts have a diameter of 16¼ inches. The propellers are of manganese bronze with three blades each. Their diameter is 15 feet 9 inches, the mean pitch 17 feet 8 inches, and the developed surface 63 square feet.

There are four main condensers, two for each engine-room, with a total cooling surface of 19,375 square feet. In each engine room the circulating water is supplied by two centrifugal pumps, driven by compound engines. Each pump is capable of delivering the circulating water to each of the two condensers independently or to both of them, and to draw from the bilges 1,000 tons of water per hour. There are in each engine room, also, two single air pumps of the Weir type. There is also in each engine room an auxiliary condenser of 10,764 square feet.

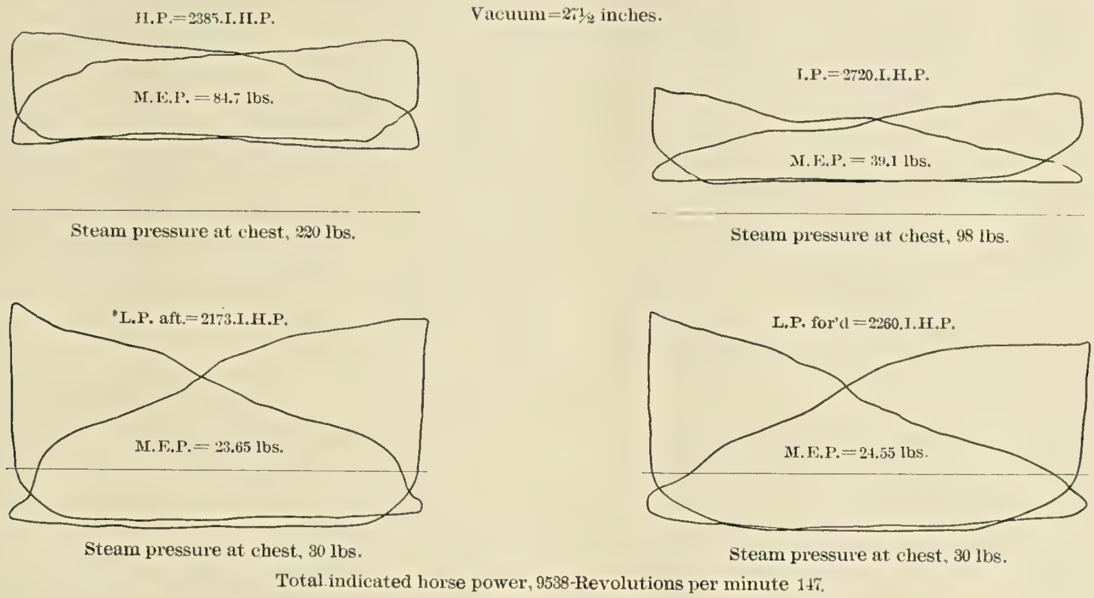


FIG. 4.—INDICATOR CARDS FROM THE ENGINES OF THE S. GIORGIO.

The revolution counters are of the Molinari type. The other auxiliaries placed in the engine room are as follows: Two Ansaldo's evaporators complete with pumps, each capable of supplying 36 tons of fresh water during twenty-four hours; two independent bilge and fire pumps and four fans. There is no hot well, the air pumps delivering into the feed tanks directly.

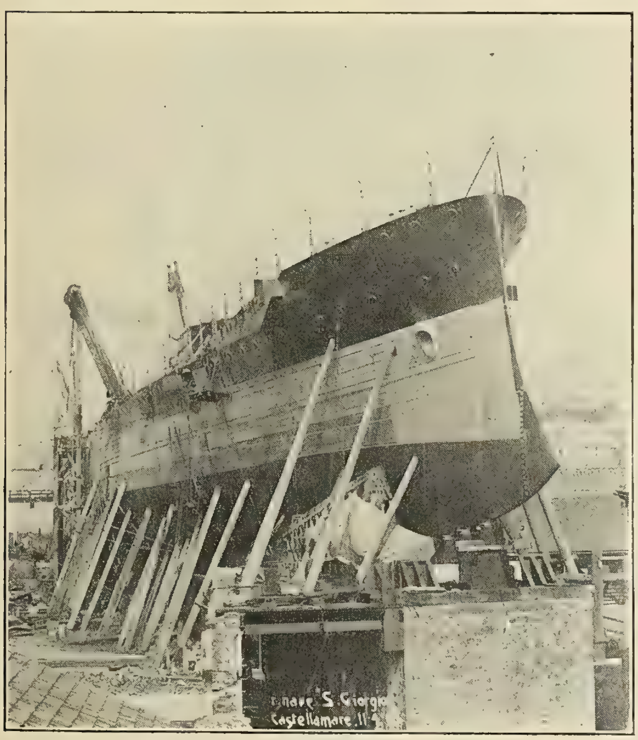


FIG. 5.—THE S. GIORGIO BEFORE LAUNCHING.

There are fourteen "Blechynden" watertube boilers, arranged in four compartments, situated eight forward and six aft of the engine room. The total heating surface is 49,794 square feet, and the total grate surface 1,314 square feet. There are four funnels, having a total area of 200 square feet.

Two Weir feed pumps are placed in each boiler compartment, each being capable of supplying the water necessary for all the boilers in its compartment. Forced draft of the closed stokehold system is obtained by means of fourteen fans. There are, besides, eight electrical ash hoists. The main and auxiliary steam pipes are of solid drawn steel.

The first and official full-power sea trial took place between Nalpes and Spezia Feb. 24 last. The speed measured while the ship was developing her maximum power (about 19,000 horsepower) was 23 knots, and the coal consumed 1¾ pounds per horsepower per hour.

THE MARINE STEAM ENGINE INDICATOR—XIII.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

The engines having been warmed up and gradually worked up to full power the drum-spring tension should now be tried. Oil the drum spindle bearing and guide pulley, being careful not to grease the cord, if possible to avoid it. It is desirable that the tension should be as small as possible, and to this end the spring should be slacked well back. Put a card on the drum. With one hand pull down the hook on the drum cord as far as it will go. Catch the bowline in the other hand, so that it can be easily hooked on, and raise the bight or loop until the pull of the reducing motion can just be felt as the engine crosses the bottom center. With the loop adjusted, as before described, the point of the hook will reach a quarter of an inch or more beyond the top of the bowline, and the hook is engaged without difficulty. If the operation is conducted in the manner described, it makes no difference whether the engine is standing still or making 400 turns a minute, the connection is made with equal facility. The drum being in motion, apply the pencil to the card, gradually slacking off the swivel stop so that a faint, fine horizontal line is drawn. Unhook the cord. Have a small hook attached to some stationary part of the engine near the indicator. Throw the bowline over this

hook, to keep it from whipping about on the grating. Remove the card from the drum, and measure the length of the line drawn. If the line is the same length as the one drawn when calibrating the reducing motion, the spring tension is correct. If the line is longer the drum has over-traveled, due to inertia. Increase the spring tension a little and try again. Repeat the operation until the over-travel is reduced to a minimum. By the time this operation has been completed a peculiar click will probably be noticed about the indicator each time the engine crosses the top center. If this is the case hook the forefinger over the bowline and pull the cord gently to one side. This shortens the cord, and if the drum is striking its stop on the top center the noise will cease. Unhook, shorten up the standing part of the cord (Fig. 86), and pull the turns around the shank of the hook. A hitch of this kind, while it will not jam under pressure, rarely ever slips; but if it should trouble by slipping make an additional hitch around the "standing part," as shown. The adjustments and tests now being complete, the actual work of taking the diagrams may be commenced.

TAKING THE DIAGRAM.

If possible, an indicator should be fitted to each end of the main engine cylinders, but the usual outfit furnished a ship provides but one indicator for each cylinder. Before attaching the indicators, blow the pipes and cocks out thoroughly, and have any water which may have been blown about the working station immediately wiped up. Attach the indicators to the cocks, line up, and hook on the cords to see that all is correct, and if found so unhook again. Have some filtered cylinder oil at hand in a wide-mouth bottle[1]. Oil the pencil motion with watch oil, dip the indicator piston in the cylinder oil, and allow the surplus to drain back in the bottle. Examine the working surface of the piston carefully. If there is any dirt in the oil it is easily seen on the bright metal surface. Put the pencil motion in place, and open the cock so that steam will enter the indicator and at the same time blow out of the small hole at the side of the cock. Place the finger on the pencil lever, just above its connection to the piston rod, and with a gentle pressure follow it up and down. The whole mechanism should work smoothly, and if the motion feels "gritty" the cause should be ascertained and removed before proceeding. The pencil motion being in good order, wash the hands; put a card on the drum and hook on the cord. As soon as the steam blowing out of the side vent of the cock appears to be dry turn the steam full on the indicator, setting the cock so as to close the side vent. Screw in the swivel head stop so that the pencil cannot touch the card. Then, swinging the pencil motion against the stop, slack away on the screw until a faint line appears on the card. If a three-way connection is in use, turn the three-way cock and take a diagram from the other end.[2] Shut off the steam, and after a few seconds' interval again apply the pencil to the paper and draw an atmospheric line. Be sure that all cocks are wide open when taking the diagrams.

Unhook the cord, remove the card and again turn on the steam to keep the instrument warm. If the preliminary card is good, with the lines faint but clear, proceed with taking the regular series of cards. If the sea is smooth and the engines turning steadily the pencil should be held on the paper during one revolution only, but if the engines are racing ever so slightly, or the load is at all unsteady, the pencil should be in contact for at least two revolutions. An observer should be stationed to read the receiver gages, clock and counter at regular intervals, and the counter should be read for the unit figure on even minutes, as denoted by the second hand of the watch or clock. An observer should be at each cylinder in charge of the indicators on that station. The diagrams should be taken in sets, one from each end of each cylinder. All the cards of a set should be taken at the same time and they should all bear the same number, the sets being numbered consecutively. The observer at the gage should keep track of the "set numbers" and fix the time for taking. As soon as all of the cards of a set are taken they should be removed and numbered and blank cards fitted to the drums. The drum end should be examined for chafe, and if distress is apparent at any point the chord should at once be renewed in order to be ready for the next set. If the trial is of long duration, the top of the pencil lever at a point over the piston rod should be frequently felt in order to detect any fouling of the piston. If fouling is indicated remove the piston at once, wipe it off with cloth—not water—and dip it in the cylinder oil. It is convenient to have a clean box on the grating[3] for each observer to keep his gear in. A rough partition can be made near one end. In the narrow compartment thus formed the diagrams and blank cards can be stowed. In the main part of the box should be some waste, clean rags, a spare coil of stretched indicator cord, a cylinder oil bottle, a typewriter squirt can filled with watch or other fine oil and last, but not least, an old glove for use if it becomes necessary to handle any of the instruments while they are hot. The indicators on the high-pressure engine are the hardest to operate correctly, owing to the high pressures and excessive heat, and the most experienced man on the staff should take that station instead of going to the low-pressure, where the "old hand" will usually be found. Cards covered with greasy finger marks show bad workmanship, and the hands should be washed every time a diagram is taken if this be necessary for the production of neat work.

CARE OF THE INDICATORS.

When finished with the indicators remove them and plug the cylinder cocks. Remove the bowline, dry it and coil it down in the bottom of the box belonging to one of the indicators which is used on the corresponding cylinders. Wipe out the indicator cylinder with a soft cloth or tissue paper, using a soft pine stick to reach the bottom. Remove the piston and spring from the rod. Clean the pencil mechanism and pay particular attention to the piston rod where it passes through the cylinder cover. Spread a piece of clean cloth on the medium-pressure valve chest cover, place the instrument and its various parts on the cloth, fold one side of the cloth over all and make fast to the cover studs, so that there will be no danger of anything falling. After an hour in this position all of the moisture which has escaped the wiping will have disappeared. Grease all the steel and unplated brass parts, including the cylinder walls and piston and put the instrument together with the exception of the spring. This should be kept on its peg in the box. If the indicator is to be used often the writer prefers to keep the springs in a small vial of light mineral engine oil. The springs must be kept free from rust. Corrosion reduces the size of the wire, thus changing the scale, and scouring or scraping still further reduces the size. When all parts are properly prepared place the instrument carefully in its box. If the tray does not go down so as to permit the cover to close easily, the tray should be removed and the instrument properly placed. The box will hold everything that came in it without any forcing. Keep the box locked. If the indicator is not used again for several weeks it should be well wiped out with gasoline or benzine and freshly oiled before using again. This removes any gum that may have formed and presents it for use in good condition.

(To be continued.)

[2]It is a good plan to take a preliminary card from the top end of each
[1]A small vaseline bottle is excellent.
cylinder only. Make these cards with a big T and the scale of the spring . These data need not be marked on any other card of the set until the work is finished.

[3]A wooden soap box without a top is excellent.

Test of Thornycroft Boilers, Fuel-Oil Apparatus and Fire-room Fans on Torpedo-Boat Destroyer Roe.*

BY C. F. BAILEY.

On April 14, 1910, tests were made at the works of the Newport News Shipbuilding & Dry Dock Company to note the working of the Thornycroft boilers, fuel-oil burning apparatus and the fire-room forced-draft fans installed on the torpedo boat destroyer *Roe*.

The installation for the ship consists of four boilers of the Thornycroft type, built by the Newport News Shipbuilding & Dry Dock Company, two being installed in each fire-room. Each boiler contains 4,500 square feet of heating surface. The boilers are fitted for oil burning only.

The oil-burning apparatus in each fire-room includes twenty-two oil sprayers and two oil heaters of the Thornycroft type, built by the Newport News Shipbluilding & Dry Dock Company, each having 66.7 square feet of heating surface.

The steam pumps are of the Davidson make. In each fire-room there is one light-service oil pump of the vertical simplex type; size, 6-inch steam cylinders, 7-inch oil cylinders by 12-inch stroke, for pumping oil from the bunkers to the tanks abreast the boilers. There are two fuel-oil pressure pumps of the vertical duplex type; size, 4½-inch steam cylinders, 2¾-inch oil cylinders by 6-inch stroke, which draw from these tanks and discharge through the heaters to the burners. There are two main feed pumps installed in the engine room, of the vertical simplex type, with 14-inch steam cylinders, 10-

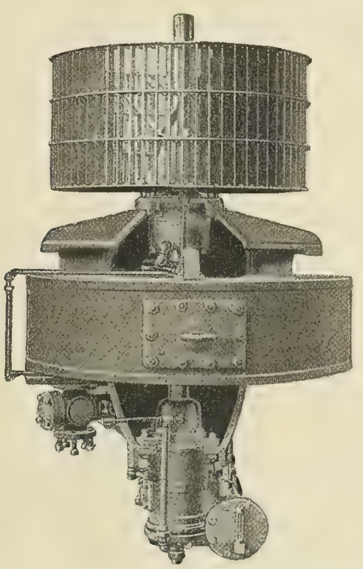


FIG. 1.—TERRY STEAM TURBINE AND SIROCCO FAN.

inch water cylinders by 12-inch stroke. There is one combined air and circulating pump with 6-inch steam cylinder, 8-inch air cylinder, 8-inch water cylinder by 8-inch stroke. There are several other pumps not used in the test which are not listed.

The auxiliary condenser contains 250 square feet of tube surface. It is fitted with ordinary ⅝-inch tubes, No. 18 B. W. G. thick.

The forced-draft fans were furnished by the Terry Steam Turbine Company, and are of the Sirocco type built by the American Blower Company. Each fan is direct connected by a vertical shaft to a Terry steam turbine, as shown in Fig. 1. The fans are 30 inches in diameter by 15½ inches width of runner. The distributor is stationary, and is of the form indicated in Fig. 2. The fans were designed to furnish 23,000 cubic feet of air per minute, against a pressure of 5 inches in the fire-room when running at 1,400 revolutions per minute. The bearings are oiled by a system of forced lubrication, which is self-contained in the unit. Each fan engine is provided with an emergency trip valve to stop the engine in case of accident causing excessive speed. For the purposes of the test the two boilers in the forward fire-room were used, together with the blowers and fuel-oil apparatus installed in this fire-room. Water for the boilers was taken from the city water mains and measured in tanks. As the tanks were filled they were

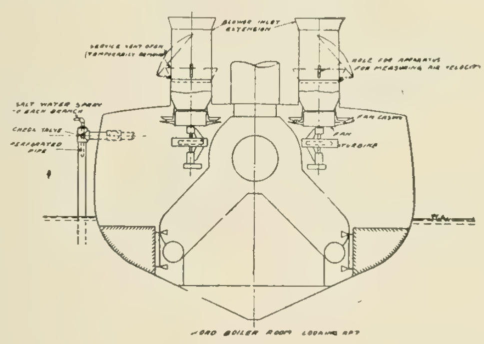


FIG. 2.

emptied alternately into the feed tank, which was provided with a tight cover and air pipe. One of the main feed pumps in the engine room was utilized to draw from the feed tank and to discharge through the feed-water heater to the boilers.

Steam from the boilers was used for running the two forced-draft blowers, the main feed pump, the auxiliary air and circulating pump, the oil heater and the oil pumps. Live steam was also used for the feed-water heater. The balance of the steam was passed through a 4-inch valve in the engine room, and thence through 7-inch pipes overboard. These pipes were carried below the water, and in the top of each pipe was introduced a 2-inch salt-water spray with perforated nozzle to act as a partial condenser for the steam. A small check valve was installed in each of these pipes to break the vacuum when shutting down. An additional 3-inch pipe was fitted overboard from the main steam, but at no time was it found necessary to use this pipe excepting for a short interval in test No. 4, and it is probable that the 4-inch valve would even then have cared for the total discharge. The 4-inch valve was regulated to maintain about 250 pounds at the boilers. A Barrus throttling calorimeter was placed in the main steam just before it entered the 4-inch valve in the engine room. The calorimeter was not lagged, and due to this and its distance from the boilers the quality of steam was probably better than indicated. The arrangement of disposing of the steam worked satisfactorily and with very little noise or vapor. A gage installed in the discharge to the 7-inch pipes from the 4-inch valve showed no pressure during most of the test.

The exhaust from the blowers was run to the auxiliary condenser in the engine room. The drain from this condenser was pumped to barrels on deck, where it was measured to determine the amount of steam used by the blowers. Live steam in the fire-room was taken to the oil heater, and the drain from this heater was taken through a drain collector provided with a gage glass, and from thence was conducted into barrels on deck, care being taken to keep the height of the water in the drain collector such as to prevent steam from blowing through.

Extensions were made to each of the blower inlets, and air-measuring apparatus, consisting of Pitot tubes, was installed in connection with the starboard ventilator to determine the velocity of air down the ventilator, as indicated in Fig. 2. The amount of air handled by the port blower was estimated from a comparison of the revolutions of the port and starboard

* From the Journal of the American Society of Naval Engineers.

SUMMARY OF TESTS OF BOILERS AND BLOWERS U. S. T. B. D. ROE.

Test No.	Time.	Duration, minutes.	Air press. in F. R., in ins. of water.	Temperature. Outside air.	Temperature. Fire-room. Above.	Temperature. Fire-room. Below	Temperature. Stack. Forw'd.	Temperature. Stack. Middle.	Boiler st'm gauge pressures. For'd.	Boiler st'm gauge pressures. Aft.	Blowers. Steam Pressure. P	Blowers. Steam Pressure. S.	Blowers. Exhaust Pressure. P.	Blowers. Exhaust Pressure. S.	Blowers. R.p.m. P.	Blowers. R.p.m. S.
1	8:31 9:41	70	1.2	61	87	94	...	...	242	246	70	69	—7″	—6.3″	805	.767
2	10:05 11:05	60	2.15	62	83	91	820	810	241	246	142	148	3.0*	4.7	1,106	1,056
3	11:20 11:50	30	3.0	63	88	95	840	850	245	249	223	225	11.9	14.0	1,348	1,275
4	12:05 12:35	30	3.25	70	90	97	860	860	250	255	245	249	14.8	17.0	1,389	1,333
5	12:45 1:10	25	3.2	72	90	97	850	890	249	254	241	248	14.3	16.8	1,357	1,285

Test No.	Fuel-oil press. To filter.	Fuel-oil press. From filter.	Fuel-oil temp., degrees. From set-tl'g tank.	Fuel-oil temp., degrees. From heater.	Steam pressure at oil heater.	R.p.m., oil pump.	Opening of burners in turns.	Fuel oil used, lbs. per hour. Total.	Fuel oil used, lbs. per hour. Per sq. ft. H. S.	Veloc. air, in feet per min., in starboard vent.	Cubic feet of air per minute to blowers. Starboard.	Cubic feet of air per minute to blowers. Port	Cubic feet of air per minute to blowers. Both.	Cubic feet air per pound oil	Temp. in feed tank.
1	158	143	69	231	205	30.7	.35	5,240	.58	...	...	...	...	...	60
2	185	174	68	229	225	48.4	.6	6,780	.75	2,080	18,150	18,750	36,900	327	60
3	187	169	67	221	241	55.2	.95	...	...	2,410	21,040	22,250	43,290	...	59
4	177	169	70	213	250	59.0	1.1	8,400	.93	2,483	21,680	23,050	44,730	327	59
5	175	165	70	210	250	58.8	1.2	9,760	1.08	2,465	21,540	22,450	43,990	271	59

Test No.	Temperature feed water.	Per cent. dry steam	R.p m., main feed pump.	Aux. cond. R.p.m., pump.	Aux. cond. Vacuum or press., ins.	Pounds of water evaporated per hour.	Actual evaporation per Square foot heating surf.	Actual evaporation per Pound oil.	Factor of evaporation.	Evap. from and at 212 degs. per Square foot heating surf.	Evap. from and at 212 degs. per Pound oil.	Fuel-oil heater. Pounds steam used per hr.	Fuel-oil heater. Lbs. oil heated per lb. steam.	Per cent. water used by oil heater.
1	199	97.4	25.0	68	16.7	72,500	8.05	13.8	1.07	8.65	14.9	547	9 6	.75
2	199	97.4	23 8	74	23 6	76,700	8.53	11.3	1.07	9.16	12.1	688	9.9	.89
3	190	97.3	28.0	78	20.2	94,200	10.46	...	1.08	11.34	...	820	...	.87
4	187	97.6	28.4	78	19.1	102,700	11.4	12 2	1.09	12 41	13.3	853	9.9	.83
5	177	97.8	29.2	78	19.2	104,800	11 64	10.7	1.10	12.79	11.8	866	11.2	.83

blowers. Each blower did its work well, and ran without heating, and with very little vibration or noise, and from observations it was apparent that each fan was doing its proper amount of work.

The fuel oil was measured by noting the height of the oil in the gage glasses on the oil tanks abreast the boilers. This was not thoroughly satisfactory in some of the tests, and the results are, therefore, not entirely consistent.

The fuel oil used was commercial oil, known as Illinois and Kansas crude.

Specific gravity, at 60 degrees F.	0.88
Degrees Baumé, at 60 degrees F.	30.0
Flash point, degrees F.	293.0
Calorific value by Mahler calorimeter, B. T. U.	19,522.0

Tests were run at varying air pressures, and the results are tabulated in the summary of tests. The oil supply was regulated to suit the combustion by adjusting the burner openings to show a slight haze of smoke, to make sure that an excess of air was not being used. The burners could have been easily run to show no smoke at the funnel, but this was not done, owing to the excess of air which might thus be heated and wasted.

Test No. 5 was run with an excess of smoke, the burners being 1.2 turns open instead of 1.1 turns open, as in Test No. 4. This was done to note if a gain in evaporation could thus be obtained. As will be seen by the summary of tests the total evaporation was slightly increased, but at the expense of an excess of oil. During the tests only one heater and one pressure oil pump were in service.

It is to be noted that with the vessel steaming ahead the power required of the fire-room fans will be reduced, and consequently the amount of air and pressure which can be obtained will be considerably increased, owing to the scoop effect of the ventilators, which will assist the fans.

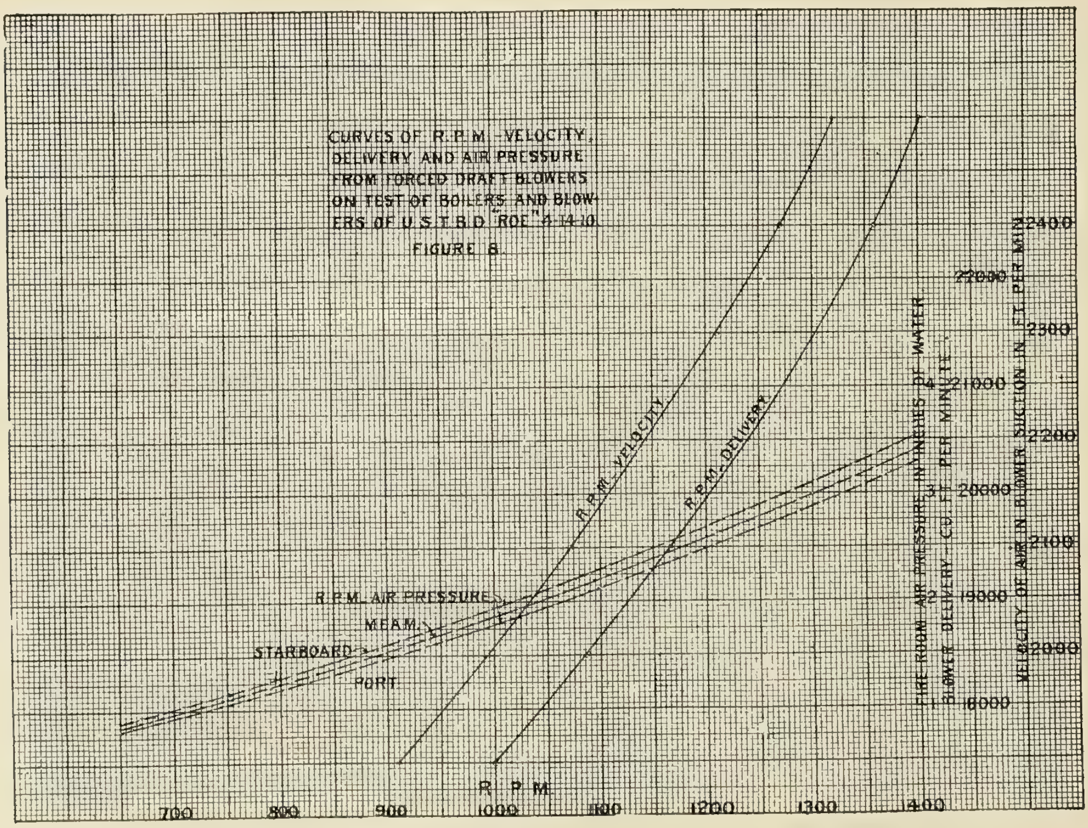


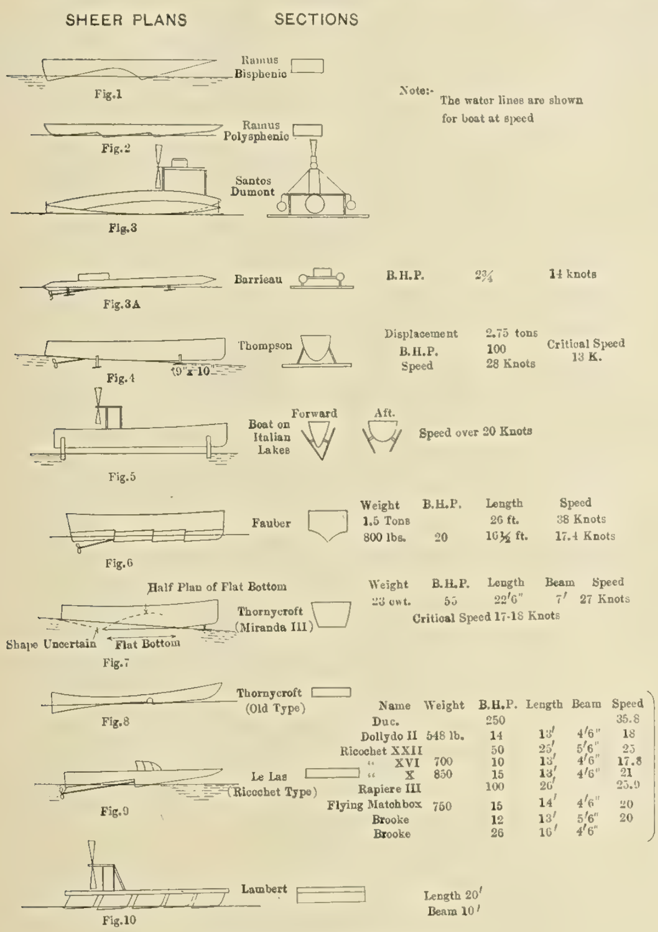
FIG. 3.—CURVES OF R. P. M., VELOCITY, DELIVERY AND AIR PRESSURE FROM FORCED-DRAFT BLOWERS OF U. S. T. B. D. ROE.

The operation of the fans, boilers and oil-burning apparatus demonstrated that the outfit is capable of supplying ample steam for the power necessary to drive the vessel at the contract speed, and the ease of control and the satisfactory working of the apparatus was such as to indicate that the installation will prove economical and successful in service.

THE HYDROPLANE BOAT.

Although this type of boat has, commercially speaking, little value, the high speeds obtained by quite moderate powers (compared with boats of ordinary shape) render it interesting to all naval architects.

The idea of eluding resistance by "skimming" the surface of the water is probably very old; the earliest authentic records, however, show that the credit of first exploiting the idea belongs to an English clergyman, Rev. Ramus. Figs. 1 and 2



TYPES OF HYDROPLANE BOATS.

show his boats. These, for want of a light source of power (A. D. 1870) were propelled by rockets, and a speed of 63 knots was once obtained.

Generally speaking, a hydroplane consists of a hull carrying two or more surfaces; in some boats incorporated with the hull and in others attached below, the surfaces have a slight general inclination, and in a few cases slight curvature. The planes, when separate from the hull, are of small dimensions in the fore and aft direction and large in the transverse. Not less than two planes is the general rule—this to obtain longitudinal stability.

GENERAL THEORY.

The reasons why a hydroplane boat has less resistance than an ordinary boat of the same weight may be understood from the following brief outline of the theory:

The waves thrown up by a boat of ordinary shape in its passage through the water are of two main types: (1) Transverse; (2) diverging. If the boat is short and the speed comparatively high, the waves set up are in case of (1) so far astern, or in case of (2) have receded so far from the boat that the energy spent in their creation is completely lost.

In the hydroplane boat, however, only the lower portions of planes are touching the water, the approximate relation between the weight of boat, speed and wetted area being

$$W = 3 A V^2 \theta.$$

θ being angle of inclination of planes. When the boat is "skimming" the pressure is suddenly applied to the water, and is immediately released—the water tending at first to move outwards from the bottom of the boat in all directions. That flowing forward reduces the relative velocity of the boat and water—that flowing aft quickly passes the step, while the water displaced in an athwartship direction tends to form waves parallel to the fore and aft line.

Immediately the plane has passed the pressure is relieved; the waves, therefore, have no time to grow to any size, and the energy spent in their creation is partially returned.

TYPES OF BOATS.

It will be quite impossible within the limits of one article to describe in detail all the types of hydroplane boats in existence to-day. These types lie in four main groups:

(*A*) Boat-shaped hulls carrying attached planes:
- (*i*) Flat planes. (*ii*) V planes.
- Santos-Dumont, Fig. 3. Italian boat, Fig. 5.
- W. B. Thompson, Fig. 4.
- Barrieau, Fig. 3A.

(*B*) Boat-shaped hulls with planes incorporated:
- (*i*) Fauber, Fig. 6.
- (*ii*) Thornycroft, Fig. 7.

(*C*) "Skimming-dish" hulls with planes incorporated:
- (*i*) Ramus, Fig. 1.
- (*ii*) Thornycroft (old type), Fig. 8.
- (*iii*) "Ricochet," Fig. 9. This is a popular type.
- (*iv*) Count Lambert, Fig. 10.

(*D*) Adjustable plane boats. There are several patents—no records of results.

(*E*) Freak boats. These are combinations of aeroplanes with hydroplanes—no practical success recorded.

There are numerous problems still unsolved in connection with hydroplanes. It will be seen at once that the ordinary stability calculations do not hold, and it is a fact that transverse stability is not easy to obtain. Fauber's boats are shaped to get more stability, and, of course, will do so if the vertical component of the dynamic pressure cuts the middle line plane above the center of gravity when the boat is inclined. Stability gained in this way must be at the expense of speed.

Even in calm water "pounding" is a source of trouble, and in some boats the occupants sit on spring seats. This is obviated by giving a boat-shaped bow to several types. Other interesting problems are:

(*a*) What is the minimum critical speed for "skimming"?
(*b*) Inter-relation between weight, speed and power?
(*c*) Position of "step"?
(*d*) Type of propellers and best position for them.

Fig. 11 shows the stream lines under a "Ricochet" type of boat below the critical speed. E. C.

FIG. 11.

OIL FUEL INSTALLATION ON STEAMSHIPS YALE AND HARVARD.

The Metropolitan Line steamships *Yale* and *Harvard*, running between New York and Boston, have recently been equipped for burning oil fuel. These ships are among the first turbine-driven vessels built in the United States; each is 386 feet 6 inches long between perpendiculars with a molded beam of 50 feet 6 inches, a molded depth of 22 feet and a normal draft of 16 feet. They have triple screws, driven by Parsons turbines capable of developing 12,000 horsepower, giving the ships a speed of about 23 knots. The boiler installation in each ship consists of twelve single-ended Scotch boilers, 14 feet in diameter and 12 feet long, located athwartships in two separate boiler rooms. There are, therefore, three boilers on each side of each boiler room. The total grate area is 756 square feet, and the total heating surface 29,520 square feet. Each boiler has three corrugated furnaces, 42 inches diameter, leading to separate combustion chambers. There are 264 plain tubes, 8 feet 5 inches long by 2½ inches diameter, and 104 stay tubes of the same dimensions in each boiler.

These ships were originally designed for burning coal, and the fuel was carried in two athwartship bunkers, one forward and one aft of the boiler space. Two hundred and fifty tons of coal were ordinarily burned on the round trip between New York and Boston, and the fire-room force consisted of forty-eight men—thirty firemen and 18 coal passers. It usually required from four to five hours to coal a ship.

In changing over to oil fuel the entire space in the forward coal bunker has been gained for other purposes, while the after coal bunker is utilized as a pump room for the oil pumps, settling tanks, etc. The oil is carried in the cellular double bottom under the boilers. At each end of the double bottom under the boiler space an oil-tight cofferdam has been built one frame space wide. The oil tanks are also divided into four separate tanks by a watertight bulkhead between the two boiler rooms and by the center keelson. Although the use of the double bottom under the boiler space is not generally favored for fuel oil tanks, yet in the case of these ships it was practically the only available space for oil storage, and, furthermore, every precaution has been taken for safety. The entire tank top has been covered with 4 inches of concrete cement, which insulates the tanks from the heat of the boilers as well as seals them tightly, so that in case of any leakage it would be impossible for gases to escape into the boiler room. The combined capacity of the four tanks is 110,000 gallons.

The fuel is taken on board at the rate of 50,000 gallons per hour from barges which are brought alongside. A 6-inch in-take pipe leads to the main deck by way of a cargo door, where a hose connection is made with the barge. There is also a steam connection to supply steam to the barge, so that no tug is required when pumping the oil on board. Each of the four tanks has a separate 6-inch connection to the main filling line.

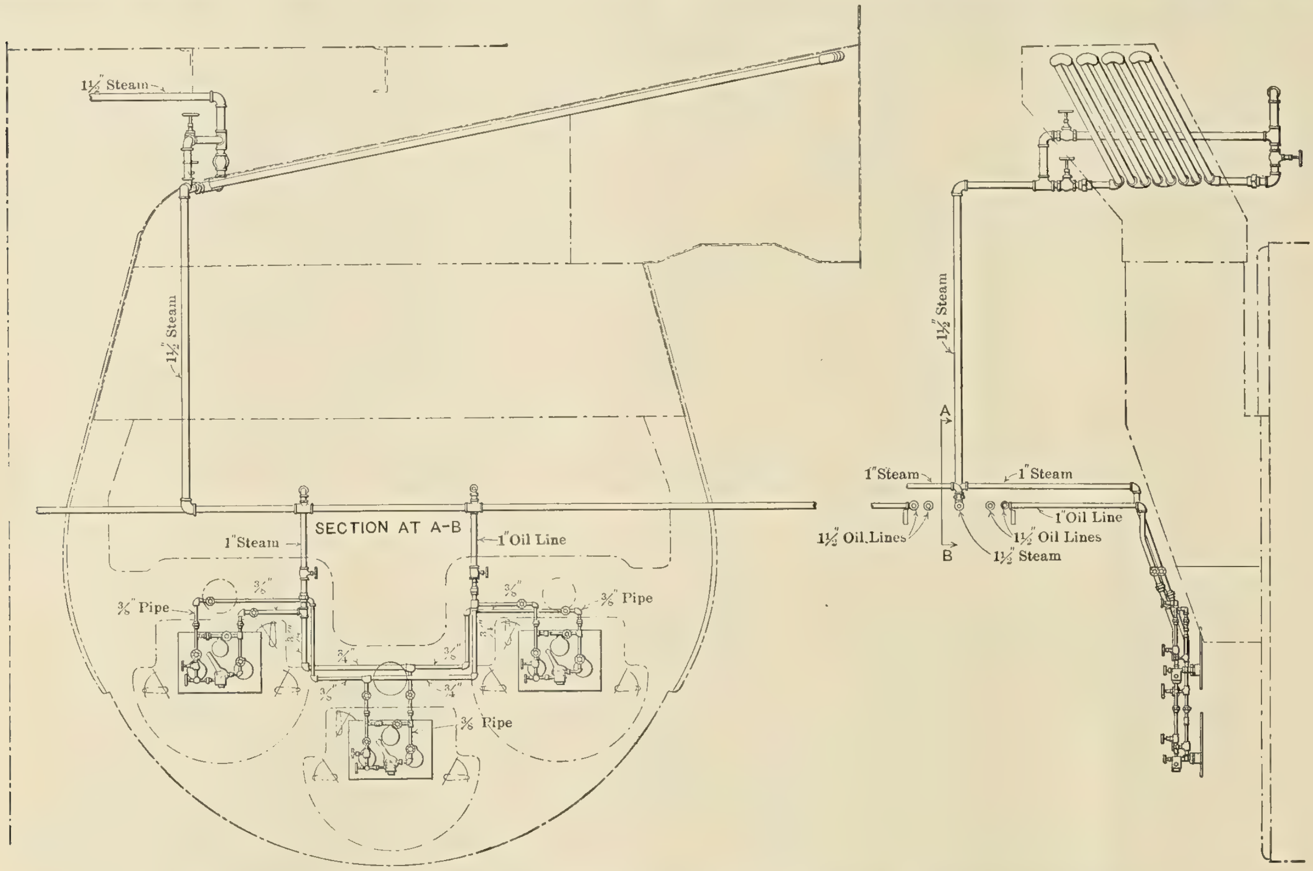


FIG. 1.—ARRANGEMENT OF PIPING, BURNERS AND SUPERHEATERS ON BOILERS OF THE HARVARD AND YALE.

An overflow valve is connected to the ventilating pipes, so that warning is given at the barge when the tanks are filled. A complete system of ventilation is supplied to the tanks whereby each has an open pipe leading from the highest point of the tank and connected in pairs to pipes which extend 20 feet above the hurricane deck on the forward side of the smokestacks. These vent pipes have mushroom-shaped covers at the top and a wire gauze protection to prevent sparks or hot cinders from entering the tanks.

The oil is pumped from each tank through 4-inch pipes, all of which lead to one valve manifold in the pump room. From here the oil passes through a suction strainer to the lift pump. The lift pump discharges into two settling tanks of 3,000 gallons capacity each. The combined capacity of these two settling tanks is sufficient for four hours' steaming in case of accident to the main tanks. The oil is allowed to settle in

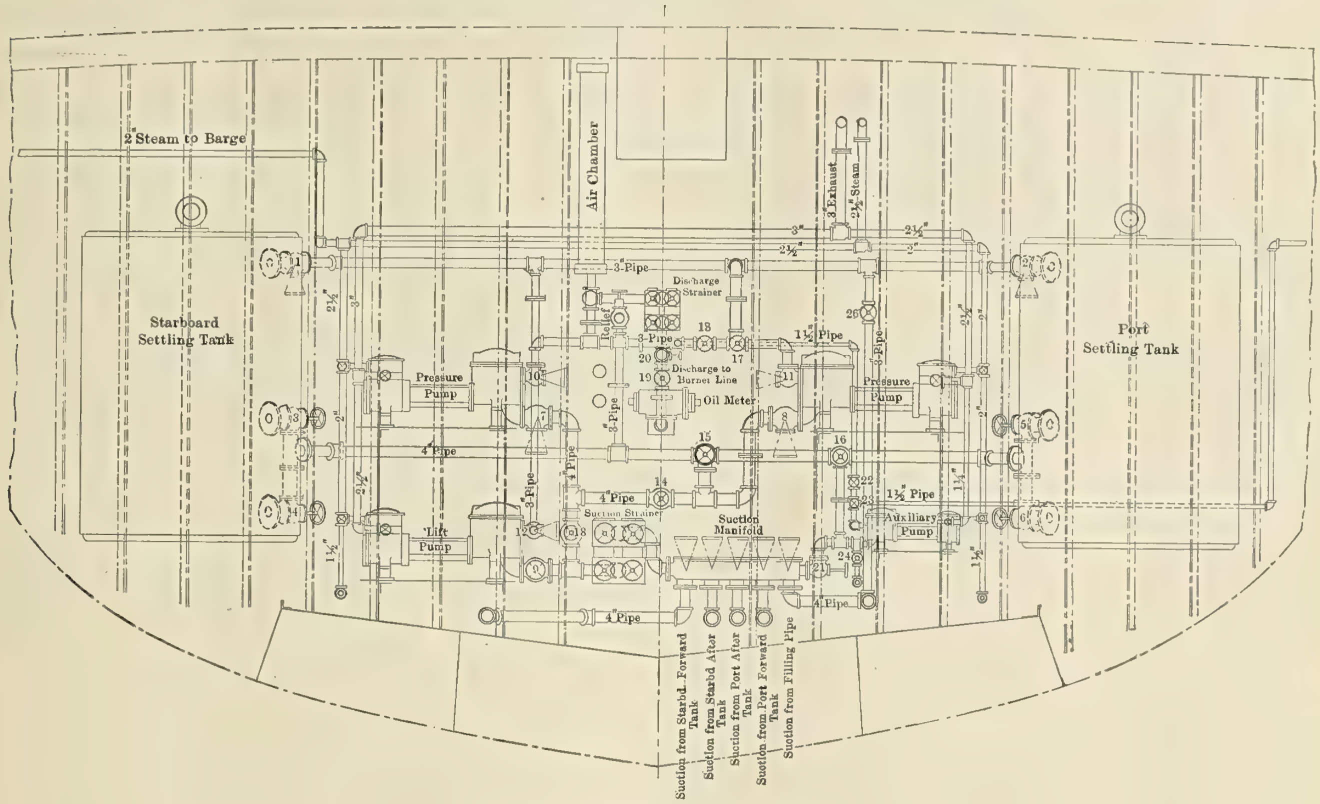


FIG. 2.—ARRANGEMENT OF PUMP ROOM.

one tank while being drawn from the other. The dirt and foreign matter in the oil are pumped overboard from the bottom of the settling tanks. A double set of oil-pressure pumps of the Warren special duplex type, 9 by 5¼ by 10 inches, draws the oil from the settling tanks at a point 4 feet from the bottom of the tanks, so that clear oil is always delivered to the burners. An extra suction is also provided at the bottom of the settling tank in case it becomes necessary to use all the oil in the settling tanks. The piping is so arranged that either pressure pump can be used as a lift pump or the lift pump can be used as a pressure pump, so that in case of accident to one of the pumps there will always be a spare pump available. In addition to this there is an auxiliary duplex 5¼ by 3½ by 5-inch pump for use in port where only one or two boilers are in service. The pressure pumps discharge to a strainer, so that the oil is strained a second time before passing to the burners. It then passes through a Worthington meter to the main pipe lines extending to the fire-room. On the main line is a valve with an extension valve stem to the main deck, so that in case

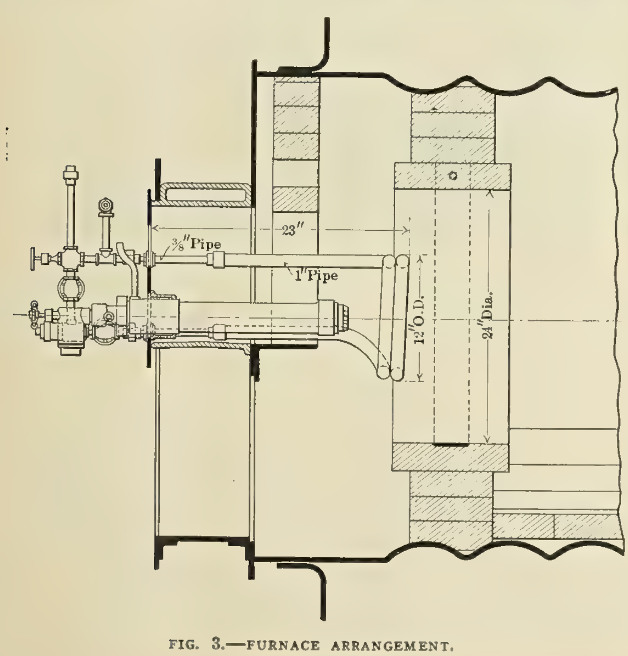


FIG. 3.—FURNACE ARRANGEMENT.

FIG. 4.—GENERAL VIEW OF ONE OF THE BOILERS WITH OIL BURNERS INSTALLED.

of accident the entire fuel supply can be cut off without entering the boiler room.

The oil is led to the fire rooms in four separate pipes, which are located, for safety, one on each side of each fire room. There is also on the discharge line in the pump room a large air chamber to insure uniform pressure on the pipe line. The oil pressure is from 110 to 120 pounds per square inch.

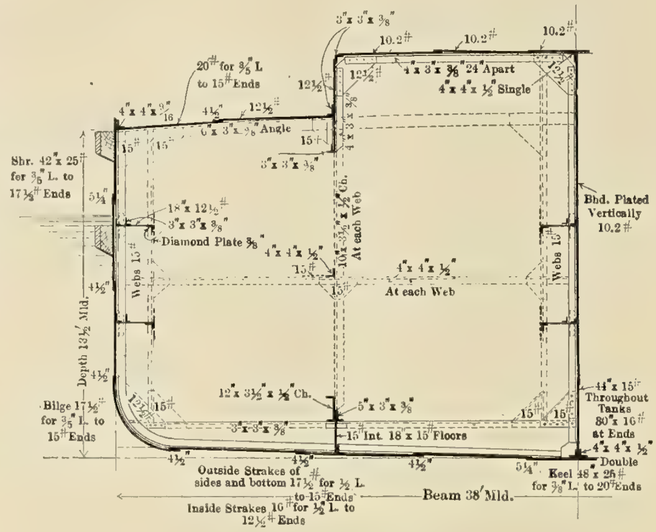
Each furnace is fitted with one 350-horsepower Lassoe patent burner designed for steam atomization. The oil is heated to a temperature of 350 degrees F., in an internal coil of 1-inch pipe, extending into the brick-lined mouth of the furnace, as shown

in Fig. 3. After passing through the coil the oil is delivered to the mixing chamber of the burner. The oil is atomized by means of superheated steam supplied at a pressure of from 100 to 110 pounds per square inch. The steam is superheated in coils placed in the up-takes of the boilers, as shown in Fig. 1.

The only changes made in the boilers themselves for the installation of the burners were the removal of the grate-bars, bearers, bridge walls and furnace doors. The mouths of the furnaces are now covered by a ⅜-inch plate, arranged as shown in Fig. 1.

The principal reasons for changing from coal to oil fuel on these vessels were that steadier steam pressure can be maintained, cleaning of fires is eliminated, and trouble with the fire-room force, which always exists to a greater or less extent on vessels on short runs, requiring a comparatively large number of men in the fire-room, is also eliminated. Besides these reasons there are a number of advantages which have been gained by the use of oil fuel which have resulted in economy. To make the run on schedule time it is necessary for the engines of these vessels to develop 10,000 horsepower. For one round trip, including port use, they consume 47,000 gallons of oil, the grade of oil used averaging 28 degrees Beaumé, weighing 7.38 pounds per gallon and having a flash point of not less than 180 degrees F. The fuel consumption with oil is 1.1 pounds per indicated horsepower per hour, as against 1.4 pounds per indicated horsepower per hour with coal. Only twelve men are now required in the fire-room force as against forty-eight which were required with coal. The cost of oil fuel is greater than that of coal, but the saving resulting from the reduction in the number of men in the fire-room force, in the lessened depreciation of the boilers, bunkers, tank top in the fire-room, and in the annual repairs to fire-room floor plates, ash guard plates and ash ejectors, and the saving in the renewal of fire bars, furnace castings, firing tools, etc., have been found to more than offset the increased cost of the fuel. Economies have also been effected in other directions, since when burning coal a force of eight men was kept at New York simply to clean boiler tubes, bilges, tank tops, etc., and also a force of twelve men was employed in cleaning the vessels from soot, cinders, in painting, etc. This work has been entirely eliminated, as well as the objectionable features of smoke, cinders, etc. Taking all these items into consideration it is estimated that by burning oil fuel a saving of $1,400 (£288) per month has resulted in the operation of both ships. It is expected that even better economy will result as more experience is gained in the use of oil fuel.

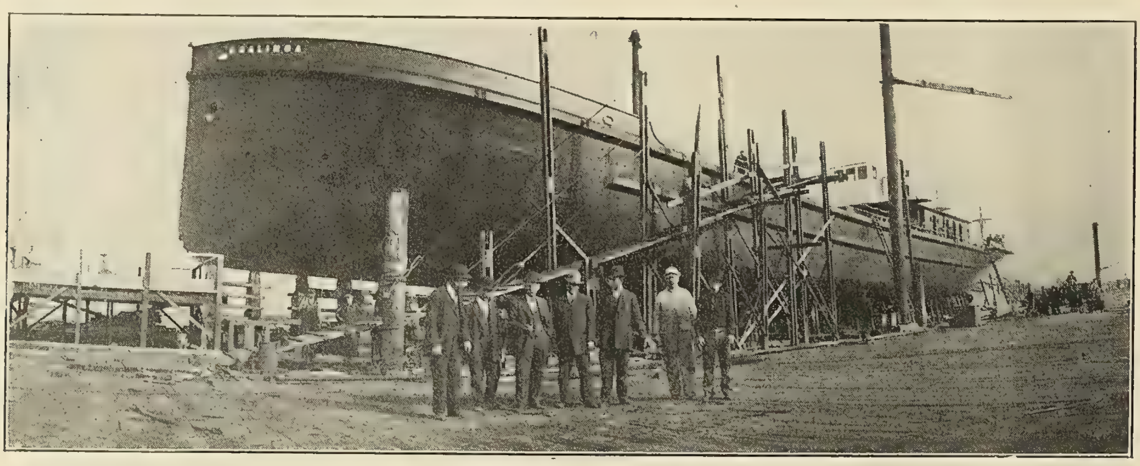
The installation was made by the W. & A. Fletcher Company, Hoboken, N. J., from plans and specifications and under the supervision of Robert McGregor, consulting engineer of the Metropolitan Steamship Company.



MIDSHIP SECTION OF THE COALINGA.

ASSOCIATED OIL COMPANY'S NEW STEEL OIL TANKER, COALINGA.

We print herewith the drawings of the first steel ship built in Oakland, California. The Moore & Scott Iron Works were the builders of the vessel, which is named the *Coalinga*. She is a steel tanker built for carrying oil in bulk, in six tanks arranged in pairs in the midship part of the vessel. The vessel burns oil for fuel and the fuel oil tanks are on each side of the vessel alongside the boilers.

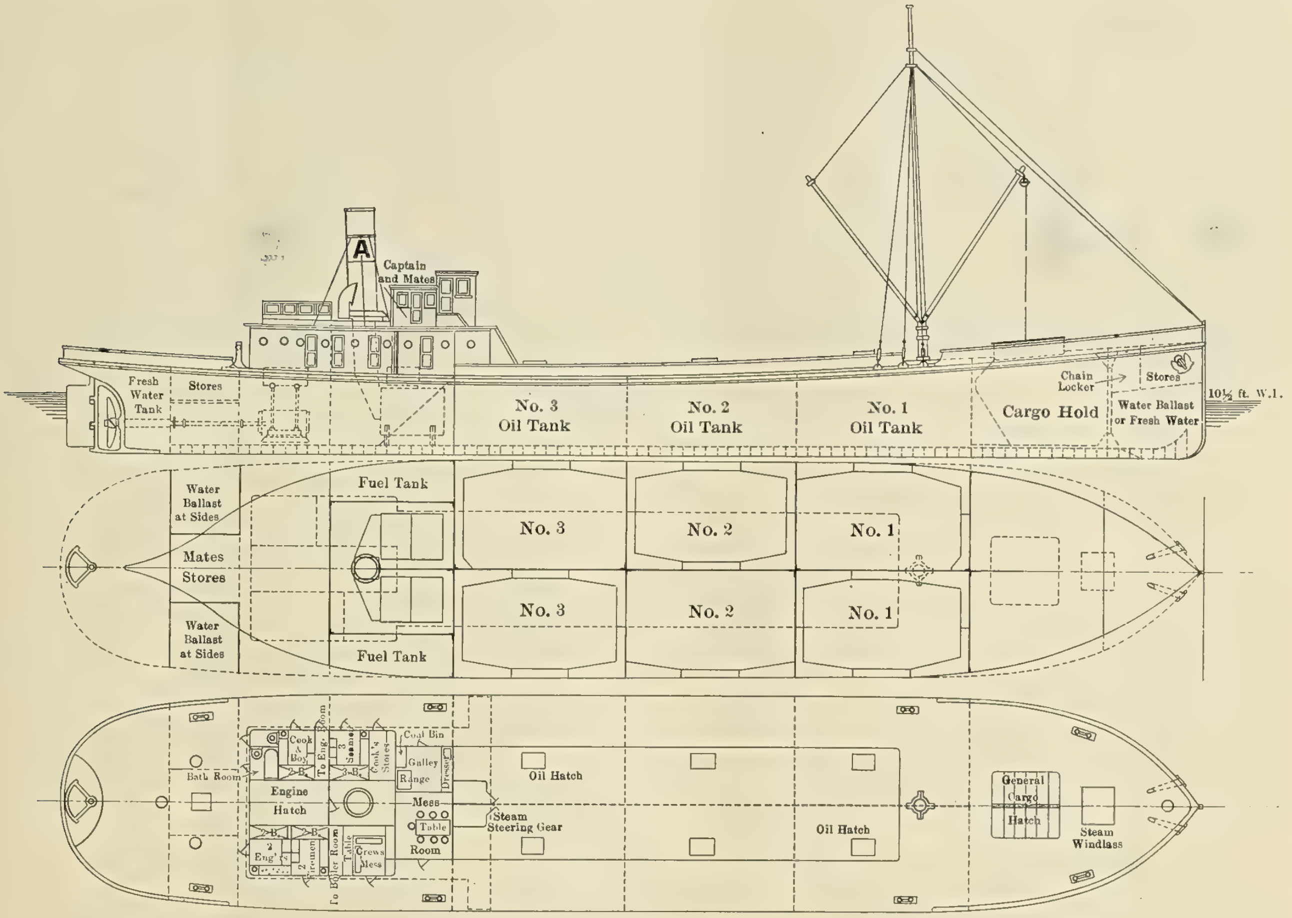


STEEL OIL TANKER BUILT ON THE PACIFIC COAST.

The principal dimensions are as follows:

Length over all	200 feet
Length between perpendiculars	194 feet
Beam molded	38 feet
Depth molded	13½ feet
Draft with 7,000 barrels of cargo	10½ feet
Total cargo carrying capacity	8000 barrels

The outline design for the vessel was prepared by the Associated Oil Company, from which the finished design was worked up by the Moore & Scott Iron Works, San Francisco.



INBOARD PROFILE, DECK AND HOLD PLANS OF THE COALINGA.

The vessel is a single deck model without poop or forecastle, with a steel house over the engine and boilers, housing the crew, on top of which is the wood pilot house and captain's room. Forward in the bow of the vessel is the storeroom and chain locker with the water ballast tank below them.

Between the collision bulkhead and the forward tank bulkhead is the pump room. Here is located all of the gear for handling the oil cargo of the vessel. The pipe line is run along each side with a valve to each tank operated from the deck above. A connection from this line also runs to the fuel tanks of the vessel.

The oil tank construction is laid out on the Dickie system, the main idea of which is the abolishing of all single riveted clips in any position whatever. There is not a clip or a bracket on the *Coalinga* that is not backed up by a clip or a bracket on the opposite side of the bulkhead, and the rivets are put through the three thicknesses. The result of this method of doing the work was that the entire tanks of the vessel were tested in eight days, being at the rate of one a day. This has never been done in the port of San Francisco before. Coupled with this system was the remarkably good workmanship of the Moore & Scott Iron Works, there being no unfair holes in the entire work, so fas as anyone knows.

The engine was built by the Moore & Scott Iron Works and is of the inverted cylinder, direct acting, compound type, with the high-pressure cylinder 14 inches diameter, low-pressure 32 inches diameter, with a common stroke of 24 inches.

The two main boilers are of the Scotch marine type, 8 feet 6 inches diameter by 10 feet 6 inches long, each with two Morrison furnaces 32 inches diameter, and with a working pressure of 160 pounds per square inch.

The oil burners are of the Staples and Piefer type, with duplicate system pumps 4½ inches by 2¾ inches by 4 inches duplex.

The vessel was launched April 30.

The Fast Steam Yacht Winchester.

The fast steam yacht *Winchester,* constructed for an American owner by Messrs. Yarrow, of Glasgow, is built on torpedo boat lines, her dimensions being as follows: Length, 165 feet; beam, 15 feet 6 inches.

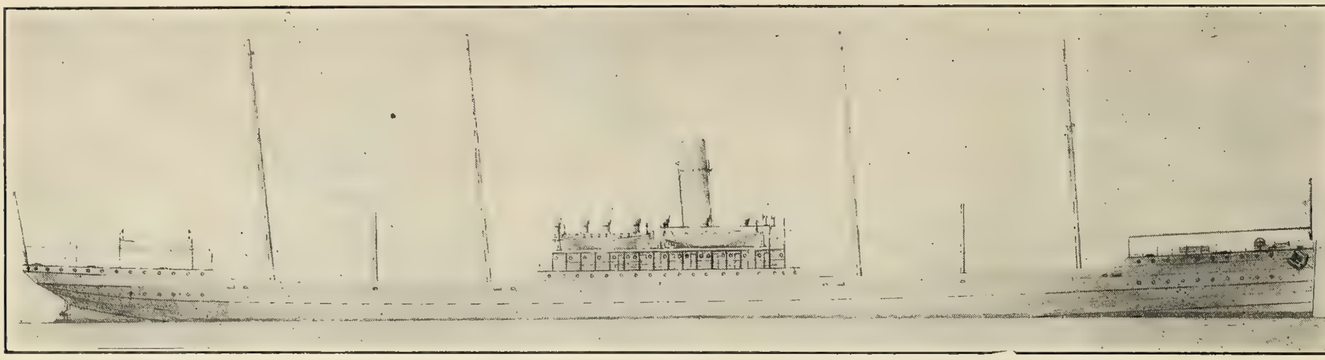
Her estimated speed was 26 knots, and the mean speed obtained on a two-hour trial 26.7 knots.

The propelling machinery consists of three turbines of the Parsons type (constructed by Messrs. Yarrow) with three shafts, one propeller on each shaft. The port shaft is actuated by the high-pressure turbine, the center shaft by the low-pressure turbine, in which is incorporated an astern turbine, and the starboard shaft by the intermediate pressure turbine.

Steam to the turbines is supplied by two Yarrow watertube boilers, constructed for burning oil fuel exclusively.

The accommodations for the owner, which are below decks, abaft the machinery space, are very commodious and handsomely decorated, consisting of a double stateroom, two single staterooms, a drawing room, bath room and toilet rooms. There is a teak deck house forward 25 feet long, containing the dining room, captain's cabin and pantry. The quarters for the officers and crew and the galley are below the main deck forward.

The vessel has a complete electric light installation and is heated by steam.



NEW DESIGN FOR A 19,200-TON NAVAL COLLIER.

DESIGN FOR A NAVAL COLLIER.

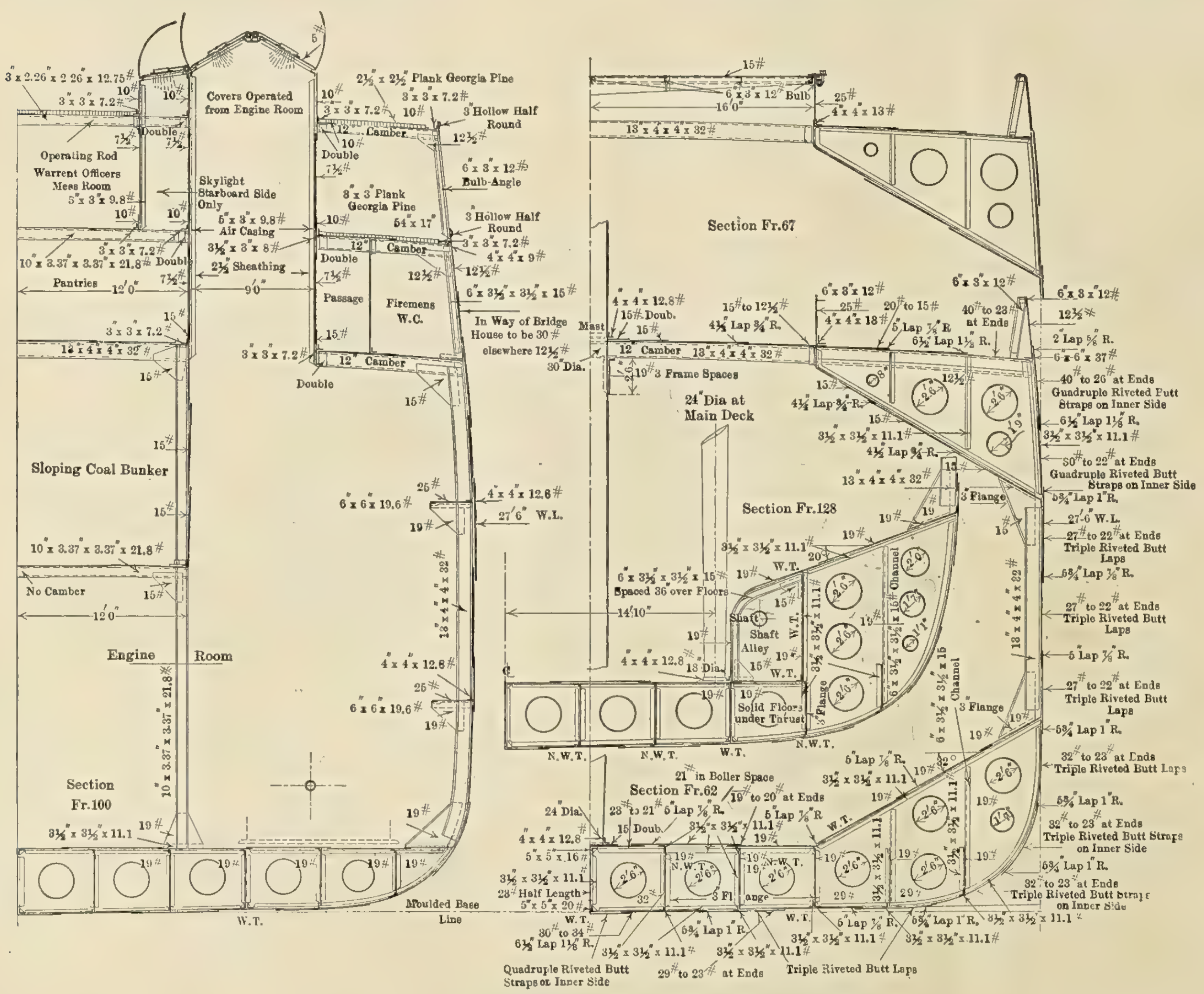
BY R. E. BARRY, ASSOC. I. N. A.

The vessel illustrated herewith has been designed by the writer to fulfil a few conditions which seemed desirable in a naval collier for supplying the fleet or a far-distant naval station. These conditions are that trim should not alter as fuel is consumed, the after holds should offer the same facilities for discharge that maintain forward, and in both all the cargo should come within reach of clam shell or other diggers, the coaling length of either the forward or after part of the deck should be as great as that of any naval vessel, and a method of transporting coal aft to a sea-coaling device should be provided. Also oil fuel for torpedo vessels should be a consideration of design.

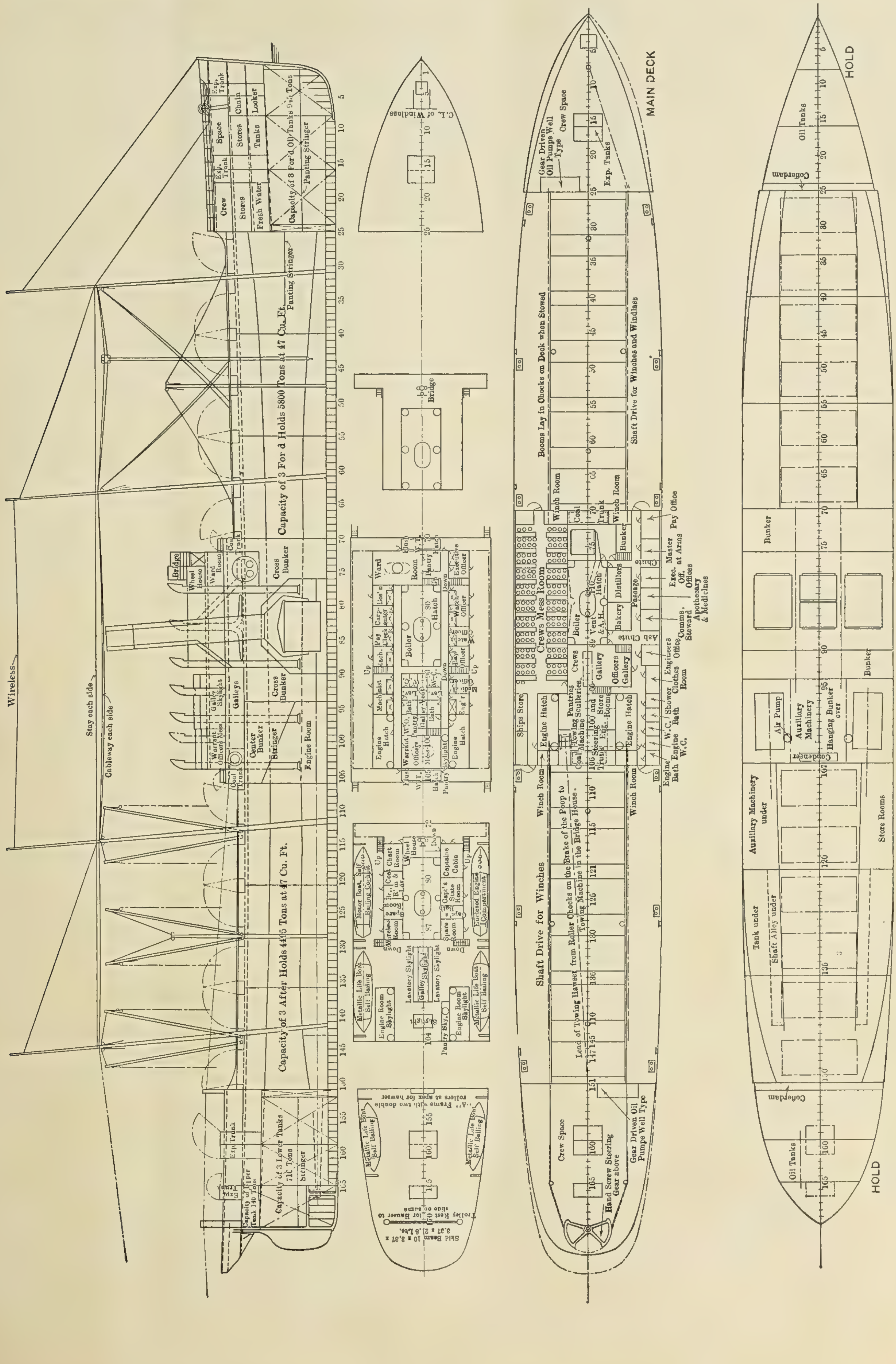
To maintain trim as usual in ocean-going vessels the fuel and machinery were placed amidships.

To avoid the obstruction of shaft tunnels in the after holds, which generally make three divisions of the lower holds, the engines were winged out as close to side of ship as possible, and the shaft tunnels thus came so far outboard that they could be fitted under the hopper sides, which are fitted both fore and aft, to cause coal to come under the hatches as it is dug out.

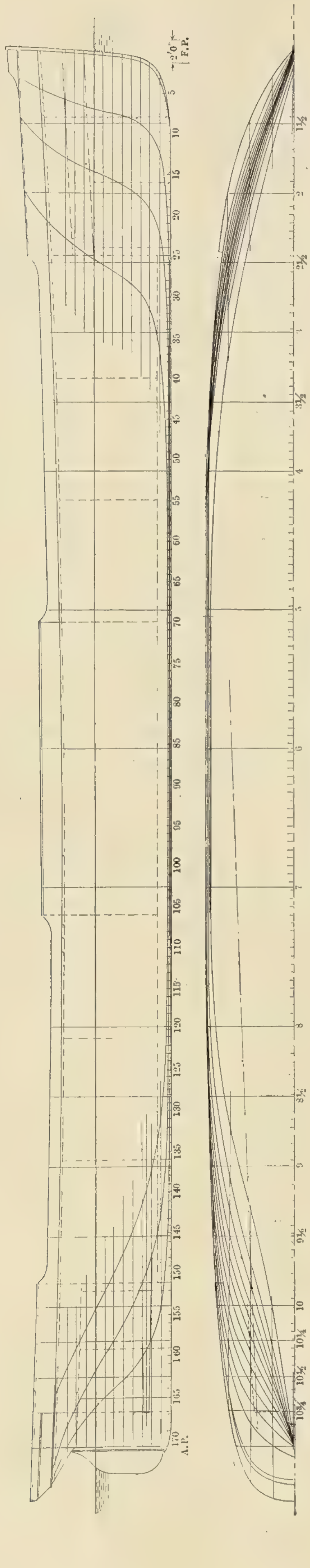
As there is ample room for any naval vessel to coal and use



CROSS SECTIONS OF PROPOSED NAVAL COLLIER SHOWING SCANTLINGS.



INBOARD PROFILE, DECK AND HOLD PLANS OF PROPOSED NAVAL COLLIER.

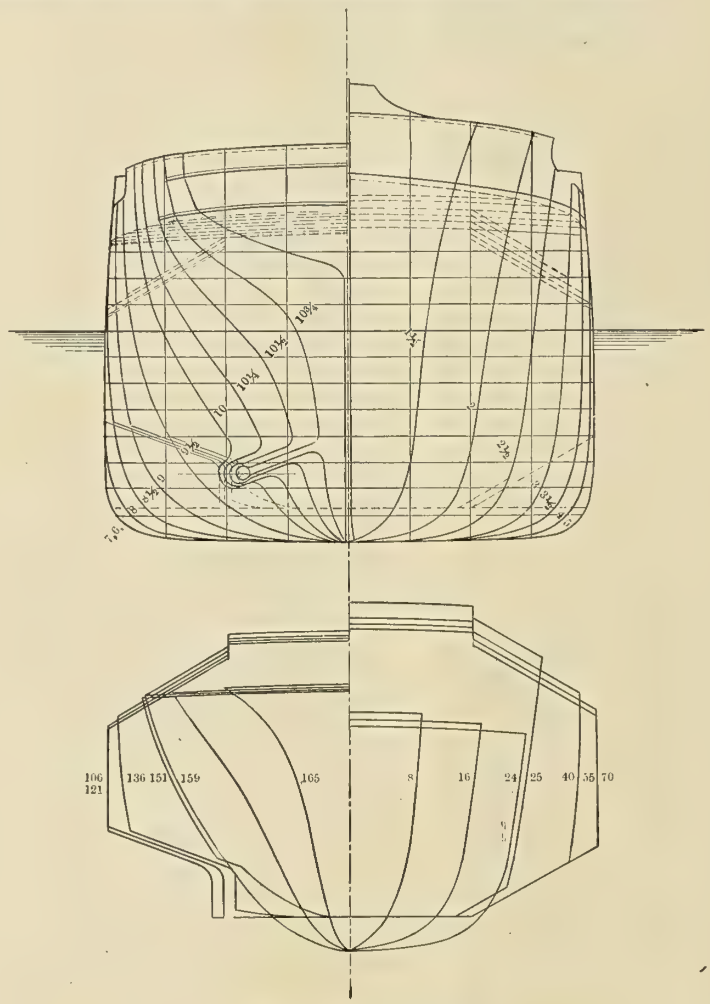


LINES OF PROPOSED NAVAL COLLIER.

all her gear either forward or aft two vessels can coal without the possibility of interference or necessity of hauling.

The arrangement of cable ways at the ends of cross trees will enable coal to be transported fore or aft to a Spencer Miller or other device for sea coaling. The cableway would be supported at each mast as in a land installation, thus avoiding the excessive sag and sway of a long span. The line of the cableway is well clear of the funnel, etc., while well within the hatches.

The lines of propeller shafting or of thrust extended forward have a long leverage about the pivoting point of the ship, thus giving the vessel great maneuvering power. Also this



BODY PLAN AND BULKHEADS.

direction of shafting will cause the propellers to cut the stream lines more nearly normally, thus increasing efficiency. As the propellers are well under the deck line there will be little danger of damage in hauling around coal piers.

It will be noticed that the vessel is club-footed aft as well as forward. This gives displacement, rigidity and accessibility with no essential disadvantages. The spread of spectacle framing is thereby reduced.

The spectacle framing is approximately in the plane of the stream lines, not horizontal, as fitted a few years ago.

Oil tanks are fitted fore and aft, which are clear of cargo or coal, and there will be no dangerous mixture of the two to be cleaned out, as would be the case if the commodities alternated in same holds on successive voyages. The oil carried will be at the expense of the coal capacity, as the vessel can load to her marks with coal alone and have a 5 percent margin in holds to spare. A body plan of bulkheads is shown which is very useful in checking hold capacities and weights.

The lines of deck shafting with the friction-driven winches allow the use of large compound hoisting engines in suitable engine rooms, where they may be kept clean and protected and the elimination of long leads of deck steam piping, with their consequent condensation of steam. Driving the windlass and oil pumps by the same method helps along these lines. The steering engine and towing machine being in the bridge house and adjacent to the engine-room make for further economy and ease of maintenance.

All cargo booms step on the deck at the side of the hatches, and when stowed alongside the hatches will be entirely out of the way when using the cableway for sea coaling. The stowed position also offers a minimum of windage. All lifts and falls will be flexible wire, and may be left aloft at all times. The only manila will be the tackles on boom guys and signal halyards.

The hatches are steel in one piece and hinged. fastened down with screw clamps and require no tarpaulins. Small manholes in the main deck with ladders on the bulkheads at the ends of each hold will be fitted as escapes or for access.

For self-trimming purposes and for top ballast to reduce metacentric height when light, tanks are fitted under the deck at the side. Access to these will be through manholes well clear of the stringer plates.

There are no stanchions in the holds, but the hatch coamings are continuous, and with the sloping face of the tanks form a rigid support to the decks between bulkheads.

Pump rooms having no openings into quarters permit oil to be handled with little danger of explosive gases finding their way into the living spaces. The pumps are geared and of the deep-well type.

The quarters are so arranged that the captain is on a deck by himself, the other commissioned officers are on the starboard side of the bridge deck and the warrant officers on the port side. As there is a passage on the deck below there is no necessity for traffic of crew by doors of officers' quarters. Besides the dining rooms for officers a general mess room is provided for the crew with fixed tables and revolving stools. This will make for cleanliness and greatly facilitate work of the mess boys and stewards. Ample berthing space, with fixed pipe berths, lavatories, showers and water closets is provided forward for the deck and commissary force and aft for the engine force. The forecastle head and poop are planked and fitted with awnings. Toilet accommodations are provided adjacent to the engine room and boiler room exits for those coming off watch.

The bridge is near the pivoting point of the ship and has office quarters adjacent.

The main engines, to suit the location, have the air, bilge and feed pumps on the inboard side abreast the low-pressure cylinder housing, and are driven by the usual levers from the crosshead. The starting and reversing gear are abreast the intermediate housings, as usual. The condensers are independent of the engine framing, and are fixed on either after engine-room bulkhead, well above the air pumps. The auxiliary machinery is located under the hanging bunker amidships. The main engines are intended to develop 7,000 indicated horsepower, and drive the ship at 14 knots. The cylinders are 27, 44 and 76 inches diameter by 54 inches stroke. The propellers are four-bladed bronze, out turning, 16 feet 9 inches diameter.

Two double and two single-ended Scotch boilers are fitted for steam at 210 pounds pressure. This arrangement allows the power plant to be operated as two units, reducing water-tending troubles with feed pumps driven off the cross heads. Ellis & Eaves' induced draft with air heaters would be fitted, also ash ejectors with clinker crushers. It will be noticed that the coal bunkers load in the same manner as the general cargo holds by large central hatches, and they will require very little trimming.

The dimensions of the hull are 512 feet between perpendiculars by 64 feet beam and 39 feet depth, with 27 feet 6 inches draft. Displacement, 19,200 tons; prismatic coefficient, .7575; 'midship coefficient, .985; block coefficient, .7475.

TABLE OF WEIGHTS.

	Tons.
Hull, including forecastle, bridge, house and poop	4,000
Houses, bridges, casings, etc	250
Carpenter and joiner work	120
Paint, cement, etc	180
Total hull weights	4,550
Steering gear	15
Ventilation, pumping and drainage	92
Anchor and cable-handling appliances	35
Boat and coal-handling and warping and towing gear	115
Masts and spars	75
Miscellaneous allowance, including hand rails, air ports, doors and small hatch covers, etc	48
Total hull fittings	380
Steam engineering weights	1,220
Reserve feed water	100
Equipment, including anchors, chain, power plant, etc	160
Outfit and stores, including ladders, boats, furniture, cooperage and blocks and ship's complement	180
Margin	110
Total displacement without bunker or cargo coal	6,700
Bunker coal	2,000
Cargo	10,500
Total	19,200

MODERN TORPEDO BOAT DESTROYERS.

In general, as in battleship design, the tendency in torpedo boat destroyers is in the direction of higher speeds and larger displacements. While the early torpedo boat was intended for intermittent attack with a very limited cruising radius, the present day destroyer is a ship possessed of sea-going qualities, and by virtue of its speed has both defensive and offensive powers.

Features which characterize the new type of destroyers are found principally to be due to engineering innovations involving the machinery for motive power and the boilers for the generation of steam. While the earlier torpedo boats generally had only one screw, driven by reciprocating engines and locomotive boilers, and a speed of 22 to 23 knots, we find the present-day destroyer, fitted with two, three and even four screws on as many shafts driven by steam turbines with water-tube boilers fitted for oil burning and speeds from 30 to 33 knots. In fact, one may readily admit that to the introduction of these engineering features the high-speed destroyer owes its existence.

The armament in early torpedo boats consisted of two deck tubes, generally one bow tube and some 3-pounders. Present-day destroyers have three torpedo tubes, four on some Japanese boats, 3-inch and 4-inch guns, together with smaller arms. The bow tube is now dispensed with.

A very considerable advantage both in operation and for the purpose of further increasing the cruising radius, as well as to render a much longer run at full speed possible without cleaning fires (in fact as long as the fuel lasts), has resulted from the use of oil fuel instead of coal. While it is true that the partial protection afforded by the side coal bunkers is practically forfeited the best tacticians do not consider that this feature involves serious disadvantages. Were it possible to

foresee a sufficiency of oil fuel supply, at economical prices, no doubt exists at all, but what this system would be almost universally introduced not only for warships but for all ships intended for high-class service. No nation is so fortunately situated, except possibly Russia, with regard to oil resources, as is the United States.

The foregoing features, taken together with further improvements to render the turbine highly economical at even low-cruising speeds, as for instance is now being contemplated by some of the first naval powers by the introduction of transmission drives, will render the modern destroyer a ship of a very perfect type mechanically.

That the destroyer of to-day is designed for the purpose of following the fleet is evidenced by construction such as to increase sea-going qualities as well as size, securing comfortable and habitable quarters for officers and crew. These features in a large degree seem to dominate in the building of destroyers of to-day; no protection to any part of either hull or machinery has as yet been resorted to.

England possesses to-day about 140 destroyers of from 250 to 600 tons displacement, with 3,500 to 9,500 horsepower, giving a speed ranging between 25½ to 30 knots; six of about 850 tons, with 33 knots speed and 14,000 horsepower; six of from 950 to 1,000 tons displacement of 33 knots and 15,500 horsepower, and one, the *Swift,* of 1,800 tons and 30,000 horsepower of about 35 knots. Besides the foregoing, contracts have been given recently for twenty others of 770 tons displacement, 14,000 horsepower and a speed of 27¾ knots. All of the latter have steam turbines and are fitted for burning oil.

Germany has completed and has under construction about 102 destroyers in size ranging between 300 and 680 tons with speeds as high as 30 knots. Those now under construction are 616 tons displacement, 10,500 horsepower and 30 knots speed, and are equipped with steam turbines of Parsons, Curtis, Zoelly and Melms Pfenninger type. The German torpedo boat destroyers are designated by letters and numbers in combination, as, for instance, S-138, the letter being the initial of the builders's name; thus S stands for Schichau, G for Germania, V for Vulcan, etc.

France owns about eighty ships of the destroyer type of various sizes. The earlier ones range in size from 300 to 425 tons, with from 26 to 30 knots speed, the later are from 700 to 750 tons with speeds up to 31½ knots. Some of the recent French destroyers have been fitted with types of machinery of widely differing nature. Thus the *Hussard, Spahi* and *Carabinier* have reciprocating engines, the *Chasseur* has Parsons turbines, the *Voltigeur* a reciprocating engine and two *Rateau* turbines and the *Tirailleur* has reciprocating engines and turbines of the De Laval type by Brequet. Boilers are either Normand, Du Temple or Guyot.

Japan has about 60 destroyers all told. In size they range between 300 and 425 tons displacement, with speeds between 26 and 31 knots. Some later additions are of 1,100 tons displacement and 33 knots speed.

The United States does not compare favorably as regards numbers with other first-naval powers. Up to date there are completed twenty-one destroyers, while fifteen are under construction and six others have been authorized by the enactment into law of the last naval appropriation bill. The table at the bottom of the page gives the particulars of destroyers completed and under construction for the United States navy.

HULL CONSTRUCTION.

The material used in torpedo boat destroyers must be, of necessity, the very best. High-tensile steel of about 75,000 pounds tensile strength is used in everything about the hull except for liners and hatch casings. The material for the rivets is also of the same high grade.

All steel material below the main deck sheer strakes is galvanized, including the outside shell plating, vertical center keel, longitudinals, frames and reverse bars, floor plates, bulkheads and stringers. The inside of the oil fuel tanks, when such are fitted, is, however, not galvanized, as liquid fuel in itself is a preservative for steel. The galvanizing is done by the hot method, and before each member is placed in position and riveted.

While the arrangement of compartments and decks differs for different service, the customary deck arrangements com-

TORPEDO BOAT DESTROYERS COMPLETED AND UNDER CONSTRUCTION FOR THE UNITED STATES NAVY.

Name of Ship.	By Whom Built.	Type of Engine.	Number and Type of Boiler.	Trial and Designed Displacement.	Estimated and Trial Horsepower.	Estimated and Trial Speed.
Bainbridge	The Neafy & Levy S. & E. B. Co.	Twin screw, reciprocating	4 Thornycroft, old type	452 trial	8,000 estimated	28.45 trial
Barry	The Neafy & Levy S. & E. B. Co.	Twin screw, reciprocating	4 Thornycroft, old type	462 trial	8,000 estimated	28.12 trial
Chauncey	The Neafy & Levy S. & E. B. Co.	Twin screw reciprocating	4 Thornycroft, old type	460 trial	8,000 estimated	28.64 trial
Dale	Wm. R. Trigg Co	Twin screw, reciprocating	4 Thornycroft, old type	457 trial	8,000 estimated	28.00 trial
Decatur	Wm. R. Trigg Co	Twin screw, reciprocating	4 Thornycroft, old type	450 trial	8,000 estimated	28.1 trial
Hopkins	Harland & Hollingsworth	Twin screw, reciprocating	4 Thornycroft, old type	467 trial	8,000 estimated	29.02 trial
Hull	Harland & Hollingsworth	Twin screw, reciprocating	4 Thornycroft, old type	440 trial	8,000 estimated	28.03 trial
Lawrence	Fore River Shipbuilding Co	Twin screw, reciprocating	4 Fore River	412 trial	8,000 estimated	28.5 trial
Macdonnough	Fore River Shipbuilding Co	Twin screw, reciprocating	4 Fore River	405 trial	8,000 estimated	28.03 trial
Paul Jones	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	8,000 estimated	28.91 trial
Perry	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	7,950 actual	28.32 trial
Preble	Union Iron Works	Twin screw, reciprocating	4 Thornycroft, old type	475 trial	7,370 actual	28.08 trial
Stewart	Gas Engine & Power Co	Twin screw, reciprocating	4 Seabury	439 trial	8,000 estimated	29.7 trial
Truxton	Maryland Steel Co	Twin screw, reciprocating	4 Thornycroft, old type	486 trial	8,300 actual	29.58 trial
Whipple	Maryland Steel Co	Twin screw, reciprocating	4 Thornycroft, old type	481 trial	8,300 actual	28.24 trial
Worden	Maryland Steel Co	Twin screw, reciprocating	4 Thornycroft, old type	476 trial	8,300 actual	29.86 trial
Lamson	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 Mosher	700 designed	10,000 estimated	28.00 estimated
Smith	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 Mosher	716 designed	10,362 estimated	28.35 trial
Mayrant O	Wm. Cramp & Sons	Twin screw, Zoelly turbines	4 White-Forster	700 designed	13,000 designed	29.5 estimated
Warrington O	Wm. Cramp & Sons	Twin screw, Zoelly turbines	4 White-Forster	700 designed	13,000 designed	29.5 estimated
Patterson O	Wm. Cramp & Sons	Triple screw, Parsons turbines.	4 White-Forster	700 designed	12,000 designed	29.5 estimated
Ammen O	N. Y. Shipbuilding Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
McCall O	N. Y. Shipbuilding Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
Burrows O	N. Y. Shipbuilding Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	742 designed	12,000 designed	29.5 estimated
Preston	N. Y. Shipbuilding Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	719 trial	10,918 actual	29.17 trial
Walke O	Fore River Shipbuilding Co	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Sterret O	Fore River Shipbuilding Co	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Perkins O	Fore River Shipbuilding Co	Twin screw, Curtis turbines	4 Yarrow	742 designed	10,500 designed	29.5 estimated
Reid	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	690 trial	12,421 trial	31.82 trial
Flusser	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	686 trial	11,541 trial	30.41 trial
Paulding O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Drayton O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Trippe O	Bath Iron Works	Triple screw, Parsons turbines.	4 Normand	740 designed	12,000 estimated	29.5 estimated
Monaghan O	Newport N. S. & D. D. Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated
Roe O	Newport N. S. & D. D. Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated
Terry O	Newport N. S. & D. D. Co	Triple screw, Parsons turbines.	4 Thornycroft, new type	740 designed	12,000 estimated	29.5 estimated

NOTE.—O = Oil fuel.

prise main deck, berth deck and forecastle deck. The berth deck is flat, while the main deck is built with a crown, amounting to ½ inch per foot of beam. The forecastle is constructed with the usual flare forward. The principal compartments, such as the engine and boiler rooms, coal bunkers or oil fuel tanks, are below the main deck. Living quarters for the officers are placed either forward or aft, being arranged forward under the forecastle in the latest American destroyers. The quarters consist of the wardroom, the commanding officer's stateroom, chief petty officers and petty officers' rooms, officers' lavatory and water closets, crew's quarters and wash rooms and water closets, galley, pantries and store rooms.

Compartments and tanks are provided with air ducts for ventilation, the water-tight and oil-tight work having to pass well-defined tests both under water and air pressure.

Forward under the forecastle deck are the lamp room, paint and oil room and windlass engine space. Under the main deck are provided hold, torpedo warhead room, handling rooms and magazines. On top of the forecastle deck is the pilot house. The wireless telegraph operating room is located convenient to the pilot house. Besides the foregoing compartments there are chain lockers, trimming tanks, reserve feed-water tanks and fresh-water tanks. On the man deck are placed the ship boats, usually two whale boats and a dory, torpedo tubes, guns, the blower vent tubes and the smoke pipes.

The deck machinery consists of windlass, anchor, boat and torpedo cranes, a steam steering engine located in the pilot house. There is usually also a hand-steering apparatus aft on the main deck. Complete sets of draft gages with outside connections and glass tubes are fitted within the ship.

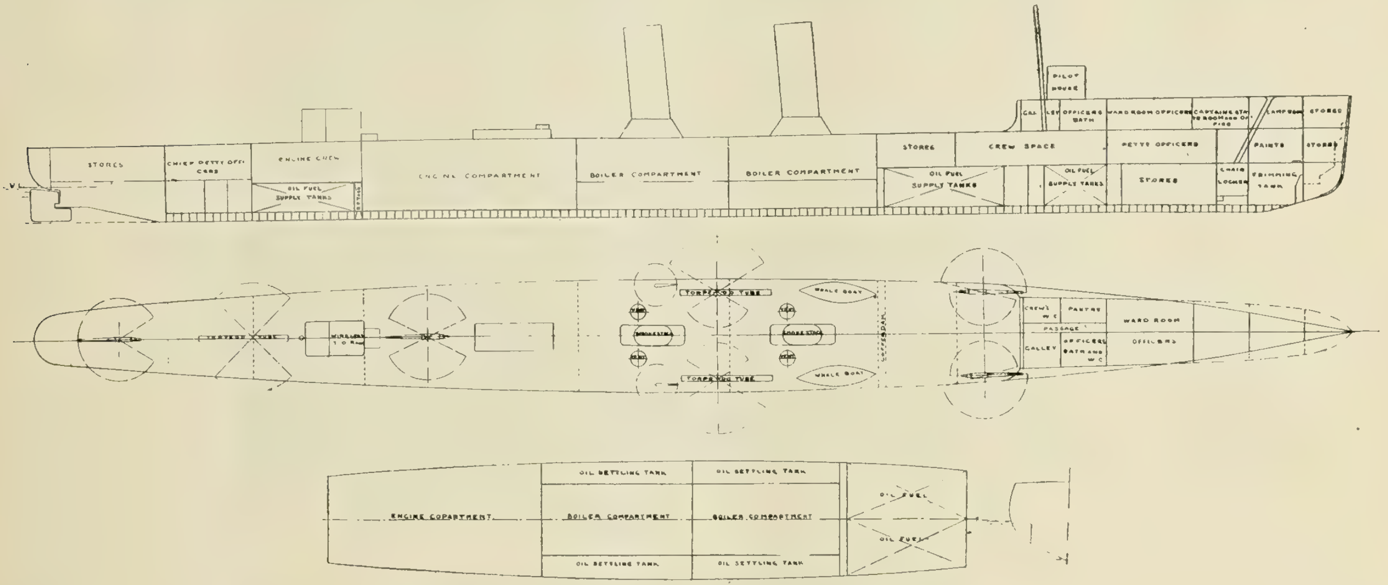
ELECTRIC LIGHT PLANT.

This consists of one or two generating sets (of about 5-kilowatt capacity each, 125 volts at the terminals). There is one (1 kilowatt) motor generator for the wireless outfit, a set of ship's running lights (combined oil and electric) and a number of electric fans of 1/12 horsepower each. The telephone service consists of two independent systems. The generating sets are operated with a normal pressure of 200 pounds per square inch gage and 25 inches vacuum. The generator is direct-current compound wound. The switchboard is placed in the engine room for the control of the electric installation, with ammeters and voltmeters, lamp ground detector and field regulator.

PUMPING, DRAINAGE AND FLOODING SYSTEMS.

In general these include the fire system, sanitary system, fresh-water system, drainage and flooding systems. The sanitary system connects with the fire main and supplies the water closets, wash rooms and galley. The fresh-water system consists of fresh-water tanks having direct connection to the distiller fresh-water pump. A hand pump suction leads from this tank with a discharge to the gravity tank, which is placed high up in the ship, supplying the galley and the drinking faucets. The fire system consists of a continuous pipe about 3 inches diameter leading under the deck beams of the engine and boiler rooms, connecting with the fire and bilge pumps in the ship, with risers along its length at suitable places.

The drainage of the engine and boiler rooms is done by direct connections to bilge pumps. Other compartments are drained either by permanent connections to the bilge pump manifold or by using temporary hose connections. The fore and after peaks have sluice valves, and drain into adjoining compartments. All tanks, cofferdams and compartments intended for trimming purposes are supplied with the usual arrangement of sounding pipes and air escape tubes. All holds, water closets, magazines, tanks and other closed compartments are ventilated by properly arranged vent pipes, ducts or hatches. The engine and boiler rooms are drained by direct connections to the fire and bilge pumps placed in said compartments, and the suction ends of the piping enclosed in strainers draw from the lowest available space. Pipes and pockets in any part of the machinery where condensed steam may accumulate are provided with drains, discharging through traps either to the feed tank or condensers. Drains from the turbines have no traps, but lead direct to either the main condensers, bilge or the turbine exhaust. In cases of emergency the magazines and warhead rooms may be flooded through specially fitted flood pipes. The trimming tanks, both forward and aft, may be flooded by connections to the fire main.



GENERAL ARRANGEMENT OF A MODERN TORPEDO BOAT DESTROYER.

HEATING PLANT.

The steam heating system is worked under a pressure of about 50 pounds gage, and is arranged in independent circuits with steam connection from the main or auxiliary steam line. About 1 square foot of heating surface is provided for each 125 cubic feet of space to be heated. The drain from the discharge coils connects, by means of a trap, to the feed tank.

REFRIGERATING PLANT.

Ice-making machinery is not usually provided in destroyers, but built-in ice chests and refrigerators are furnished separately in the spaces allotted for officers and crews.

COMPRESSED AIR SYSTEMS.

An air compressor and accumulator for charging torpedoes is placed in the engine room. It connects with the pneumatic main, which runs through the machinery space. The purposes served are for the running of pneumatic tools, blowing soot from the boiler tubes and for operating the oil-fuel service pumps while getting up steam. The air pipes and accumulators are tested to a pressure of 3,000 pounds per square inch by charging with the air compressor running.

EVAPORATING AND DISTILLING PLANT.

The number and size of evaporators and distillers are determined by the quantity of water required, and are figured on a basis of .6 square foot of heating surface for each gallon of water to be evaporated and about .4 square foot of cooling surface for each gallon of water to be distilled per hour. Steam to evaporators is taken from the auxiliary steam pipe and the feed from the distiller circulating water discharge. In the latest American destroyers the evaporators are required to evaporate 3,000 gallons of water per twenty-four hours and the distillers 1,000 gallons for the same time.

FUEL-OIL SUPPLY AND SERVICE SYSTEM.

In ships fitted for burning oil, fuel-oil storage tanks are placed below the main deck, one or more forward of the boiler room, from which they are separated by a cofferdam, and another aft of the engine room. They are divided into compartments by flats and bulkheads, each with an independent suction surrounded by a steam coil and strainer. The suction connects to a valve whose steam is acted upon by a float in the tank, which shuts the valve when the tank is filled to the proper level. Amidships and abreast of the boilers are located, low down, the settling tanks, divided into separate tanks by the boiler room bulkheads. Those on the port side are connected to the starboard tanks by means of cross connecting pipes, thus obviating independent suctions, the latter being arranged for only on one side of the ship. The settling tanks have gage glasses showing the oil level. The storage tanks are arranged with air escape pipes, sounding pipes and steaming-out connections. There is one fuel-oil supply pump for each boiler room, together with service pumps in duplicate. The suction piping to the oil supply pumps is arranged so that either pump may draw from any storage tank and to discharge to either settling tank. The steam connection to these pumps is controlled by a chronometer valve, which, by a system of links and floats in the settling tanks, closes the steam connection to the pump when the settling tanks are filled to the working level. The steam to the heating coils is taken from the auxiliary steam line. All suction and discharge pipes are made of large diameters so as to admit of low oil velocities.

MACHINERY INSTALLATION.

The destroyers now building, as well as those constructed within the last four or five years, both for the British and American navies, are generally equipped with steam turbines for the propelling machinery in one single compartment. Those of British design all have Parsons except three, contracted for by Messrs. Brown & Company, of Glasgow, which will have Curtis. In the United States navy fifteen destroyers have Persons, three Curtis and two Zoelly turbines. The latter two types have not yet been tried. With Parsons turbines three shafts are commonly used, with Curtis and Zoelly two shafts. The steam pressure at the turbine valve chest with Parsons turbines is about 220 pounds gage and 250 pounds gage with Curtis and Zoelly. No superheat is used in either. The average revolutions per minute with the former at full speed are about 800, while from 600 to 650 is estimated for the latter. Separate cruising turbines are usually installed with Parsons arrangements, and when maneuvering only the low-pressure turbines are used, which also contain the astern units. The operating platform is arranged forward with stop and operating valves located on the forward engine-room bulkhead.

The condensing apparatus consists of two condensers, two ordinary air pumps and a large circulating pump for each condenser. Modifications to this arrangement will be found in some destroyers where augmentors are fitted to increase the vacuum, and in lieu of independent circulating pumps scoop injection with a small auxiliary circulator on each condenser injection pipe. In the case of the *Voltigeur*, a French destroyer, fitted with a reciprocating engine and two turbines, there are three condensers, one for the engine and one for each turbine.

The condensers have either straight tubes, the ends having packings screwed up with ferrules, or are bent, together with the body of the condenser, to a certain radius with the tube ends expanded in the tube sheets. This latter system has the advantage of lightness.

The feed system is sometimes arranged with main feed pumps in the engine room, while the auxiliary feed pumps are placed in the fire room, or with one main and auxiliary feed pump placed in each fire room, both systems having their advocates. The pumps draw from the feed tank, and also have a suction connection from the channel way and discharge through the feed heaters into the boilers. All feed pipes are copper. The main steam pipes are run in independent circuits, with cross connections, connecting two boilers each to stop valves on the forward engine-room bulkhead. Connections are here made to the turbines through the steam strainer. Expansion joints, or large bends, are provided at all necessary places in order to counteract the effects of expansion taking place in the rather heavy and inflexible steel pipes now universally used.

Auxiliary steam piping supplies all the auxiliary machinery, and connection is made direct to it from the main line.

The lubricating system, both for main and auxiliary machinery, among the latter especially for the blowers, is of great importance. The main turbines always have an independent system consisting of two separate oil pumps, one or two oil coolers with circulating pump, oil drainage tank and temperature-reading station. The air cooler is either of the surface condenser type or the film type. In the former the water circulates four times between the tubes, between inlet and outlet, in opposite direction to the oil, which goes through the tubes. In the film type the oil is forced to take a circular motion, due to the spiral shape given the pipes, the water circulating twice over the oil in any one circuit. The cooler is placed high up, forming a gravity tank, whence the oil issues direct into the supply pipe system. Having passed all the oiling stations (bearings) the oil returns through the oil drainage system back to the oil drain tank, which is placed as low down in the ship as possible. The oil pressure in the discharge pipe is about 10 pounds. Each oil discharge pipe leading to the respective bearings is furnished with cock and coupling for disconnecting and overhauling. Sight glasses are provided to observe the flow, and thermometers to ascertain the temperature. A strainer is placed in the pump suction chest. The pipes are made of copper and are of large sizes.

BOILERS.

The type of watertube boiler used in destroyer installations is the so-called "small diameter tube" type, which is generally taken to mean a boiler having generating tubes less than 1½ inches in diameter. Among this type we find boilers known under the following names: Yarrow, Thornycroft, Schultz,

Normand, White-Forster, Mosher, Du Temple, Guyot, Schichau, and probably some others of more or less worth.

There are usually two boiler compartments with two boilers in each compartment. The number of smokestacks varies, and is usually with the Normand boiler, one for each boiler. With other types either two or three smokestacks. Since fairly economical (40 to 50 pounds steam per horsepower) small-powered steam turbines have been placed on the market, their use seems favored for destroyer work by many builders to drive the blowers. Each blower, two for each boiler room, connects, through an independent vent on the main deck, with the outside.

When oil fuel is used the grate is dispensed with, but the boiler is otherwise designed and built in the same manner as for coal, except that firebrick takes the place of ashpans.

The oil fuel systems as used in American and British destroyers operate by mechanical atomization of the oil under high pressure (150 to 300 pounds per square inch), the necessary air for combustion being supplied by the forced-draft blowers.

There are installed as parts of an oil-burning system light service oil pumps for pumping oil from the oil fuel tanks to the settling tanks abreast of the boilers. Two fuel-oil pressure pumps, which draw from the settling tanks and discharge through the oil heaters, the oil being here heated to near flash point (200 to 230 degrees F.), to the burners in which the oil is mechanically atomized and mixed with air for combustion.

The revolutions of turbine blowers are from 1,000 to 1,500, and the air pressure in the fire rooms ranges between 3 and 5 inches of water. The boiler pressures run as high as 265 pounds gage. The evaporation per square foot of heating surface in good boilers may be as high as 12½ pounds of water per square foot of heating surface from and at 212 degrees F. and 13½ pounds per pound of fuel.

SHAFTING AND PROPELLERS.

The shafting is made of high-grade steel with a tensile strength of about 80,000 pounds per square inch and is made hollow. The bearings are water-cooled and have forced lubrication.

Propellers are made of manganese bronze or Monel metal, with weights balanced and with blade surfaces planed or otherwise finished.

ECONOMY RESULTS.

At full speed the steam consumption per horsepower-hour in destroyers with steam turbines is superior to that obtained with reciprocating engines, the reverse being the case at reduced speeds. Under the former conditions 14 pounds steam per shaft-horsepower is a good, average result. or from 1.5 to 1.6 pounds of coal per shaft-horsepower developed, giving an average of 3.6 knots run per ton of coal. At one-tenth power the corresponding figures are about 23 pounds of steam per shaft horsepower hour, 28 pounds coal and 10.8 knots run per ton of coal.

FIG. 1.—NEW STEAMSHIP ALABAMA OF THE GOODRICH TRANSIT COMPANY.

IMPROVEMENTS IN THE WELIN QUADRANT DAVIT.

About three weeks ago the new steamship *Alabama*, of the Goodrich Transit Co., was put into commission, and is now in regular service on the Great Lakes. This new steamer will be fully described in a future issue, but in this article it is our intention to bring to the notice of our readers her equipment for safeguarding the lives of her passengers. The *Alabama* carries twelve metallic lifeboats, of the standard Lane & De Groot type; these are equipped with Mills releasing gear, and are operated under twelve sets of Welin quadrant davits. The accompanying illustrations show the simplicity of these davits and the compact mechanism. It is doubtful whether so many boats could have been placed in such a relatively small space without the use of this device, and yet considerably more longitudinal space might have been saved by the use of double frames between boats; however, the designers of the *Alabama* doubtless had reasons for not taking advantage of the double-frame arrangement.

The davits on the *Alabama* are of the regular Welin type, with the addition of lowering drums, which are plainly shown in Figs. 2 and 3. As can be seen, each fall is rolled on a drum, and the two drums required for each boat are keyed to one shaft and controlled by a friction band, which enables one man to lower both ends of the boat simultaneously. When hoisting the boats the falls can be rolled up independently—one drum at a time, if desired—to suit conditions. Ordinary manila falls can be used with these drums, but it is preferable to have them

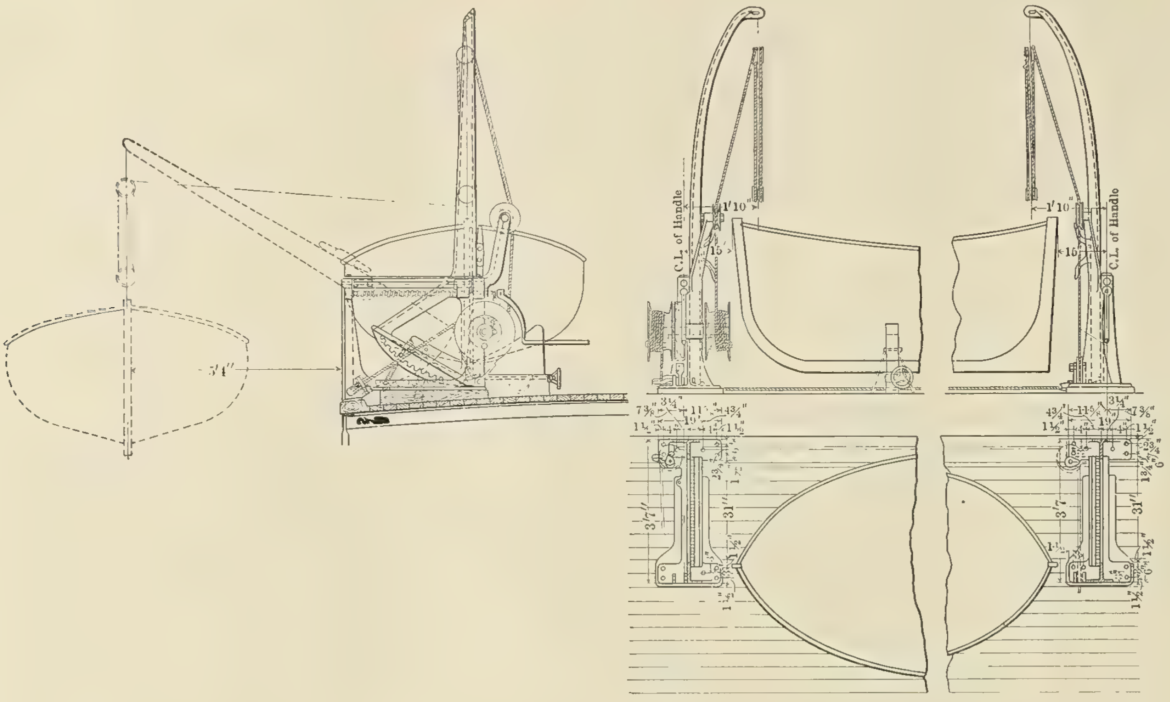


FIG 2.—WELIN QUADRANT DAVIT, WITH LOWERING DEVICE, SHOWING ARRANGEMENT OF DRUMS AND LEAD OF FALLS.

of durable wire rope, for the reason that they will not require as large a drum.

For some time past the question has been agitated of having —even with the most up-to-date boat-launching apparatus—some means for lowering both ends of a lifeboat simultaneously, by a mechanical device, and for this reason numerous patent applications have been made and patents issued with a view to covering this particular object. Comparatively few of the devices patented have real practical value, however, and the Goodrich Transit Company has apparently chosen the simplest and most efficient way of accomplishing the desired result, particularly when used in connection with tried and well-known apparatus like the Welin quadrant davits.

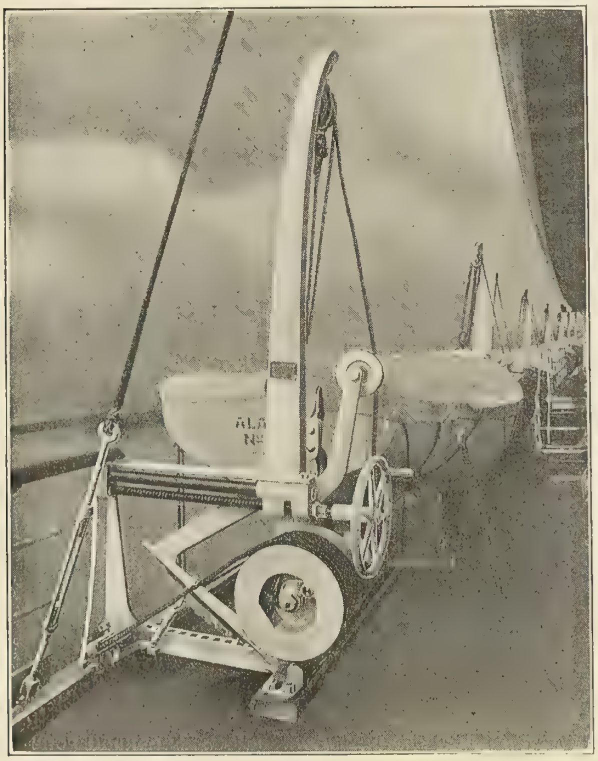


FIG. 3.—VIEW SHOWING BOAT-LOWERING DEVICE ATTACHED TO WELIN QUADRANT DAVIT ON SS. ALABAMA.

It is interesting to note that the *Alabama* is the first vessel on the Great Lakes to be entirely fitted out with these modern davits, as heretofore they have been applied principally on ocean-going passenger ships, where danger seems more imminent, and on such vessels as harbor tugs, revenue cutters, cable ships, etc., where it is imperative to be able to lower a boat quickly and under all conditions for working purposes. From the large list of marine disasters on the Great Lakes, however, it is evident that the need for modern life-saving appliances is just as great there as on the ocean, and therefore any movement to use every precaution for preventing loss of life is much to be commended.

The *Alabama* is also equipped with a modern type of life preserver. She carries 2,000 of the so-called A-B-C belts, which are made of a very light tropical wood instead of cork. This material, it is claimed, cannot crumble and deteriorate as does the latter, and the impervious composition with which the wood is covered keeps it always buoyant, no matter how damp the atmosphere. Furthermore, a vessel can carry one-third again as many of the A-B-C belts in the same stowage space as for ordinary belts, because they are one-third lighter and smaller than the ordinary belts.

Among the latest installations of Welin quadrant davits ordered in Europe are the equipments for the *Titanic* and *Olympic,* the gigantic White Star liners now building. These vessels will be fitted with the double-acting quadrant davits. Each vessel will carry sixteen sets of these davits, and this provides for the handling of thirty-two lifeboats, each over 30 feet long, as with this style of davit two boats can be carried under each set. The advantages of this modification in the Welin davits, *i. e.,* the double quadrant, is so apparent that it scarcely requires comment. On the basis of this design

the British Board of Trade made a new ruling regarding the carrying of two boats under one set of davits, and when so conservative a body as the British Board of Trade takes such action in a matter of this kind there is no doubt but that other nations will soon follow their lead, especially as the advantages of the concession are undoubtedly great. In the first place more lifeboats can be carried on a ship; second, the cost of installation is reduced, and, third, the reduction in weight is considerable, amounting to something like 30 percent. Then there is the possibility of improving the whole deck arrangement by clearing the more valuable sections of the deck and shifting the boats elsewhere, where free space is of less importance. We think it is safe to predict that there will be a little revolution in davit equipment on some of the older ocean passenger steamers as soon as the new White Star boats are in commission, or even sooner, as many lines abroad are already considering alterations in their boat decks on certain of their old ships, with a view to gaining promenade space. In such cases the concession by the British Board of Trade, above referred to, naturally proves of immense assistance.

It has often been asked whether the Welin quadrant davits have actually been the means of saving lives, and in this connection the following story may be of interest: The *Star of Japan* was wrecked on the West Coast of Africa some time ago. Two of her lifeboats were provided with Welin davits, and the two remaining ones were slung from the ordinary type. In the captain's report of the catastrophe it was made quite clear that not only had the latter proved useless under the adverse circumstances prevailing at the time, but also that the saving of every soul on board was due to the efficiency of the Welin davits. The owner of the vessel, the late Mr. Corry, of London, emphatically asserted that henceforth no other type of davit should be fitted to his ships. The next order received by the Welin people was only for three sets, however, while it was known that the ship would carry four boats, and upon inquiring into the cause for this discrepancy, the Welin Company's representative learned that one set had been fished out from the wreck, brought home, and would now be refitted to the new steamer—the *Star of Canada*. The Welin Company is arranging to fit a suitable memorial plate to that particular set of davits.

Here is an instance, therefore, where the Welin davits have saved the lives of an entire ship's crew, and when we consider the innumerable marine disasters and the thousands of lives lost owing to "inability to launch the boats on one side of the ship," or, in other words, inefficiency of the boat-launching devices, the moral obligation of vessel owners to provide for the safety of their passengers and crews is clearly pointed out.

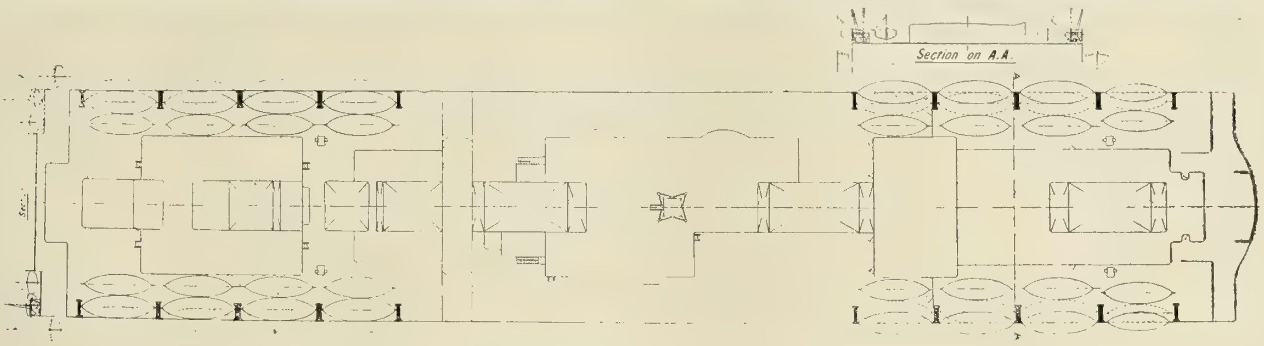


FIG. 4.—ARRANGEMENT OF BOATS ON NEW WHITE STAR LINERS OLYMPIC AND TITANIC.

Lloyd's Register Shipbuilding Returns.

From the returns compiled by *Lloyd's Register of Shipping* it appears that, excluding warships, there were 394 vessels of 1,118,587 tons gross under construction in the United Kingdom at the close of the quarter ended June 30, 1910. The tonnage now under construction is about 61,000 tons more than that which was in hand at the end of last quarter, and exceeds by nearly 373,000 tons the total building twelve months ago. The figures of the warship tonnage now being built (378,523 tons displacement) are the largest reported since June, 1901.

Rulings of the Office of the Supervising Inspector-General of the United States Steamboat Inspection Service.

That part of section 19, rule 11, relating to reinforcing holes exceeding 6 inches in diameter cut in boilers for pipe connections, manhole and handhole plates, it has been held "that the reinforcing ring referred to must be of iron or steel plate, and the flange of a cast steel valve or fitting would not be a proper reinforcement for such holes under the rules and section referred to, except on boilers carrying 75 pounds or less steam, when the flange of a stop valve of sufficient thickness may be used as a reinforcement of such opening."

The matter of whether a steam dredge drawn to the shore by the use of a steam windlass on the dredge, said dredge having neither a propeller or water-wheel or a helm, is subject to the inspection of this service, this office has held that dredges such as described above are not subject to inspection.

It has been decided by the United States Navy Department to convert the *Arethusa* into an oil-fuel ship, and this work is being done at the Norfolk navy yard. The vessel will carry about 4,000 tons of liquid fuel and will be of use in connection with the oil-burning torpedo boat destroyers now in service and others of that type destined shortly to be commissioned.

The Attorney-General of the United States has rendered an opinion concerning the effect of the clause in the naval appropriation act of June 24, applying the so-called eight-hour law of 1892 to the contracts for the construction of the one battleship and two fleet colliers which are to be built by contract, to the effect that "the provision must be construed to apply simply to work done upon the vessel itself at the place where it is built, and not as applying to the manufacture of machinery of other material elsewhere which is to enter into the construction of the vessel."

Robert H. Laverie was appointed by the administration of the Bureau Veritas as chief surveyor for the United States, beginning his services June 1, 1910. Mr. Laverie's headquarters are at that society's New York offices, 17 State street, where he is prepared to render any services required in his capacity as naval architect and marine engineer, either in connection with classification or private surveys of any description.

COMPARATIVE TRIALS OF AMERICAN SCOUT CRUISERS.*

The board appointed by the Navy Department to carry out comparative tests of the main and auxiliary machinery of the scout cruisers United States ships *Birmingham, Salem* and *Chester* has submitted a report, embracing an analysis of the results obtained, together with a copy of the data recorded during the various tests made.

The object of the tests was to ascertain and compare the steam economy of the three types of propelling machinery fitted in the vessels named, the hulls being practically of the same model, at various speeds while underway and under as nearly as possible identical conditions. In order to make the comparison complete six distinct series of tests were carried out, as follows:

I. Tests of auxiliary machinery (vessel in port).

II. Boiler evaporative tests (vessel in port).

III. Standardization runs. Each vessel was standardized over the Rockland measured mile course just prior to undertaking the (IV.) steam-consumption tests. As will appear later, this involved standardizing the *Salem* on two different occasions, as two series of steam-consumption tests were carried out. In these trials, moreover, and as well as all other (V. and VI.) sea runs, the aim was to load each vessel so that the displacement for each trial should be as nearly as could be calculated in the beginning, an average of 4,000 tons. All ships were dry-docked prior to standardization and coal-consumption trials, and the bottoms cleaned and painted.

IV. Steam-consumption tests of main and auxiliary machinery (vessel under way).

V. Coal-consumption tests of about 1,000, 750 and 2,000 knots at speeds, respectively, of 10, 15 and 20 knots.

VI. A full power run of twenty-four hours' duration. The *Birmingham* was unable to complete this trial on account of a defect which developed in the machinery. This vessel, after finishing twelve hours of the test, slowed down and returned to port.

* Abstract of report of Board on Comparative Trials of the scout cruisers *Birmingham, Salem* and *Chester*, by Capt. F. H. Bailey, Commander Gustav Kaemmerling and Commander W. W. White.

PRINCIPAL HULL DATA.

The hulls of all vessels, except in minor particulars, are alike. Steel is used throughout, and the outside plating generally is on the raised and sunken strake system. The frames, spaced 36 inches apart, are generally of channel section, 6 by 2 13/16 by 2 13/16 by 13.3 pounds.

The outside plating, below the load waterline, consists of 15-pound plating, reduced to 12-pound at the ends, and of 12-pound plating elsewhere. Flat keel plates, about 36 inches in width, are in two thicknesses; the inner of 17½ and the outer of 20-pound plate. The vertical keel, about 39 inches in depth, is of 15-pound plate. Garboard and sheer strakes are 17½ pounds, reduced to 15 pounds at the ends. Nickel-steel

TABLE I.—SYNOPSIS OF HORSEPOWER, STEAM AND COAL CONSUMPTION.

Number of test.	Duration of test.	Name of ship.	Displacement.	Speed per hour in knots.[b]	Horsepower. Machinery necessary to propulsion. Main engines or turbines. I. H. P.	Main engines or turbines. S. H. P.=.94×I. H. P.	Auxiliaries. I. H. P.	Total. I. H. P. (f+h).	Total. H. P. (g+h).	Steam. For all purposes per hour from curves of steam consumption tests.	Make up feed.[a] Tons per day.	Make up feed. Pounds per hour.	Actual total on test in pounds (m+o).	Reduced to water evaporated from and at 212° per pound of coal. Actual on this test.	As established by boiler evaporative tests.	Coal for all purposes per— Day. Cubic feet.	Day. Tons (43.5 cubic feet=1 ton).	Hour. Pounds.	Pounds per hour per knot.	Pounds per square feet of grate surface.	Per I. H. P. of machinery necessary to propulsion.	Per H. P. of machinery necessary to propulsion.	Auxiliaries exhaust into—
a	b	c	d	e	f	g	h	k	l	m[c]	n	o	p	q	r	s	t	u	v	w	x	y	
1	Hrs 96	Birmingham..	3,994.0	9.86	960	902.4	61.4	1,021.4	963.8	32,871	10.10	942.2	33,813	11.60	11.12	1,398	32.14	2,999	304	17.02	2.94	3.11	Second receiver, both engines.
		Salem.........	4,022.0	9.90	......	668.4	115.1	....	783.5	44,674	11.66	1,088.3	45,762	9.52	10.85	2,342	53.85	5,026	508	21.67	....	6.41	E.R. auxiliary condenser, 40 minutes; main condenser, 29 hours 40 minutes; remainder third stage, forward turbine.
		Chester.......	4,026.9	10.03	......	730.0	105.1	....	835.1	36,097	10.97	1,023.8	37,121	9.54	9.64	1,830	42.06	3,926	391	16.92	....	4.70	Port L. P. turbine.
2	50	Birmingham..	4,001.9	15.00	3,263	3,067.2	89.2	3,352.2	3,156.4	67,438	13.90	1,297.3	68,735	10.87	11.20	3,098	71.21	6,646	443	14.32	1.98	2.105	Second receiver, both engines.
		Salem.........	3,964.5	14.91	......	2,609.2	170.2	....	2,779.2	84,280	12.12	1,131.2	85,411	9.06	10.86	4,665	107.23	10,008	671	21.56	....	3.60	Third stage, forward main turbine.
		Chester.......	3,967.8	14.98	......	3,201.3	128.1	....	3,329.4	74,596	13.20	1,232.0	75,828	9.73	9.50	3,887	89.36	8,341	557	20.54	....	2.51	Port L. P. turbine.
3	98	Birmingham..	3,960.0	19.83	7,575	7,120.5	188.7	7,763.7	7,309.2	129,176	26.10	2,436.0	131,612	9.62	10.90	6,675	153.45	14,322	722	20.58	1.84	1.96	Second receiver, both engines.
		Salem.........	4,030.5	20.25	......	6,883.3	329.0	....	7,212.3	163,111	17.51	1,634.2	164,745	9.54	10.60	8,788	202.03	18,855	931	27.09	..	2.61	Third stage, forward main turbine.
		Chester.......	3,970.3	19.90	......	8,374.0	206.2	....	8,580.2	134,270	16.80	1,568.0	135,838	9.55	9.44	7,086	162.90	15,205	760	21.84	..	1.77	Starboard L. P. turbine.
4	12	Birmingham..	4,059.0	24.00	14,828	13,938.4	535.9	15,363.9	14,474.3	271,545	120.4	11,237.3	282,782	8.42	9.52	16,344	375.72	35,070	1,461	50.38	2.28	2.42	Main condensers.
	24	Salem.........	4,028.0	24.32	......	14,630.0	695.8	....	15,325.8	293,103	45.63	4,258.3	297,361	8.36	9.25	18,060	415.15	38,749	1,593	55.74	....	2.53	Main condenser, 30 minutes; remainder fourth stage, main turbines.
	24	Chester.......	3,961.6	25.08	......	19,632.0	463.6	....	20,095.6	314,161	27.00	2,520.0	316,681	8.70	8.03	18,679	429.40	40,078	1,598	57.42	...	1.99	Starboard L. P turbine

[a] It is assumed that all the make-up feed was evaporated.
[b] Speed of each ship was taken from its standardization speed-revolution curve.
[c] Correction was made for the difference in the running of the auxiliaries of these tests and their corresponding steam consumption tests.

TABLE II.—SYNOPSIS OF HORSEPOWER NECESSARY TO PROPULSION.

Number of test.	Duration of test.	Name of ship.	Speed per hour in knots.	Number of turbines in use.	Steam pressure (gage). Engine room. Forward.	Steam pressure (gage). Engine room. After.	Steam pressure (gage). Steam chest main engines or initial turbine. Forward.	Steam pressure (gage). Steam chest main engines or initial turbine. After.	Vacuum (inches of mercury). Forward.	Vacuum (inches of mercury). After.	Revolutions (per minute).[a] Forward starboard.	Revolutions (per minute).[a] After port.	Revolutions (per minute).[a] Mean.	Horsepower. Machinery necessary to propulsion. Main engines or turbines S. H. P.[b] Forward starboard.	Main engines or turbines S. H. P.[b] After port.	Main engines or turbines S. H. P.[b] Both.	Auxiliaries I. H. P. Augmentor.	Auxiliaries I. H. P. Wet vacuum pumps.	Auxiliaries I. H. P. Dry vacuum pumps.	Auxiliaries I. H. P. Main air pumps.	Auxiliaries I. H. P. Main circulating pumps.	Auxiliaries I. H. P. Main feed pumps.	Auxiliaries I. H. P. Forced-draft blowers.	Auxiliaries I. H. P. Oil pumps.	Auxiliaries I. H. P. Total (t+u+v+w+x+y+z+aa).	Grand total (s+bb).
a	b	c	d	e	f	g	h	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	aa	bb	cc
	Hrs.																									
1	96	Birmingham..	9.86	...	210.0	209.0	50.0	48.7	25.0	27.2	73.02	73.03	73.02	451.2	451.2	902.4	.....	.....	.....	11.9	17.8	19.0	12.7	.....	61.4	963.8
		Salem.........	9.90	2	217.9	220.4	145.3	152.0	29.6	29.1	138.23	138.23	138.23	328.6	339.8	668.4	.....	19.2	37.5	.....	24.0	25.3	8.0	1.01	115.1	783.5
		Chester........	10.03	6	179.0	189.0	59.0	......	28.8	29.0	204.04	202.36	203.20	392.0	338.4	730.4	39.4	.....	.....	19.1	17.0	29.1	.....	.55	105.1	835.1
2	50	Birmingham..	15.00	...	214.0	214.0	98.0	103.0	25.6	26.8	111.88	111.95	111.91	1,495.5	1,571.7	3,067.2	.....	.....	.....	12.9	20.0	30.7	25.6	.....	89.2	3,156.4
		Salem.........	14.91	2	220.9	219.8	174.8	177.7	28.9	29.0	209.30	209.30	209.30	1,397.8	1,211.4	2,609.2	.....	19.5	38.2	.....	34.0	57.4	20.0	.92	170.0	2,779.2
		Chester........	14.98	6	197.0	202.0	159.0	......	28.3	28.9	313.60	310.47	284.43	1,621.3	1,580.0	3,201.3	40.6	.....	.....	14.0	32.4	40.5	.....	.61	128.1	3,329.4
3	98	Birmingham..	19.83	...	209.6	206.4	173.7	172.0	23.6	26.7	149.84	149.84	149.84	3,616.2	3,504.3	7,120.5	.....	.....	.....	16.0	31.0	62.0	79.7	.....	188.7	7,309.2
		Salem.........	20.25	2	220.6	220.6	189.1	181.0	28.3	28.6	282.27	282.27	282.27	3,423.6	3,459.7	6,883.3	.....	22.0	37.4	.....	92.8	72.2	103.5	1.08	329.0	7,212.3
		Chester........	19.90	5	172.0	176.0	147.0	......	28.0	28.9	407.02	432.68	419.85	3,470.0	4,904.0	8,374.0	37.8	.....	.....	26.1	60.5	75.0	6.0	.82	206.2	8,580.2
4	12	Birmingham..	24.00	...	250.0	238.0	229.0	226.0	25.0	26.3	189.90	189.10	189.50	7,380.0	6,558.4	13,938.4	.....	.....	.....	24.4	48.0	153.5	310.0	.....	535.9	14,474.3
	24	Salem.........	24.32	2	231.0	234.0	209.0	204.4	28.0	29.0	342.93	357.56	350.25	6,990.0	7,640.0	14,630.0	.....	33.2	37.2	.....	94.0	101.0	429.0	1.42	695.8	15,325.8
	24	Chester........	25.08	4	212.0	216.0	204.0	201.0	28.3	29.1	560.90	555.10	558.05	10,005.0	9,627.0	19,632.0	45.8	.....	.....	29.6	128.4	156.6	101.7	1.52	463.6	20,095.6

[a] As determined from counter readings at beginning and end of test.

[b] S. H. P. of Birmingham = .94 × I. H. P.

protection (80-pound plate) of variable width, extends fore and aft in wake of engine, boiler and dynamo rooms.

The weight of hull, including nickel-steel protection, but without machinery, coal, stores, outfit, armament and ammunition, etc., is approximately 2,015 tons. Principal dimensions are:

Length between perpendiculars, feet	420
Length over all, feet and inches	423—2
Length on L. W. L., feet	420
Breadth, molded, feet and inches	46—8
Breadth, extreme, feet and inches	47—0¾
Ratio of length to beam	8.97
Draft (official contract trial, 3,750 tons displacement), feet and inches	16—9
4,000 tons displacement, feet and inches	17—4½
4,710 tons displacement (about fully loaded), feet and inches	19—2¾
Displacement per inch at mean draft (16 feet 9 inches), tons	31.07
Area of midship section (3,750 tons displacement), square feet	566
Area of L. W. L. section (3,750 tons displacement), square feet	12,960
Wetted surface section (3,750 tons displacement), square feet	19,900
Coefficient (at 3,750 tons displacement):	
Block	.40
Midship	.72
L. W. L. plane	.66
Coal bunker capacity in tons (43 cubic feet per ton):	
Birmingham	1,395.3
Salem	1,388.3
Chester	1,407

MACHINERY INSTALLATIONS.

The machinery installations of these vessels have been described in previous issues, but the following recapitulation, as set forth in the report, may be of interest: The *Birmingham* and *Salem* are each equipped with twelve boilers of the Fore River type; heating surface, 37,992 square feet; grate area, 696 square feet; ratio, 54.5 to 1; steam pressure, 250 pounds. The *Chester* is equipped with Normand boilers; heating surface, 32,040 square feet; grate area, 696 square feet; ratio 46 to 1; steam pressure, 250 pounds. Details of the engines are as follows:

Birmingham.—The engines, which turn the propellers outboard, are of the vertical inverted four-cylinder, direct-acting, triple-expansion type, with unjacketed cylinders, placed in two watertight compartments, and operating twin screws. Each engine was designed for an indicated horsepower of 8,000 at 200 revolutions per minute, with a steamchest pressure of 250 pounds gage. Beginning forward, the order of the cylinders is, forward low-pressure, high-pressure, intermediate-pressure, and after low-pressure. The forward low-pressure and high-pressure cranks are opposite, as are the intermediate-pressure, and after low-pressure the second pair being at right angles with the first. All main valves are of the piston type, worked by double-bar Stevenson links. There is one piston valve for the high-pressure and two each for the intermediate-pressure and low-pressure cylinders.

Engine framing is of forged steel, cylindrical columns, trussed by forged-steel stays. All crank, thrust, line and propeller shafting is hollow, and shafts, piston and connecting rods and working parts, generally, are of forged steel.

CYLINDERS.

Number for each engine	4
H. P. diameter, inches	28¼
I. P. diameter, inches	45
F. L. P. diameter, inches	62
A. L. P. diameter, inches	62
Diameter of piston rods, inches	6
Stroke of all pistons, inches	36

PROPELLERS (MANGANESE BRONZE).

Number of blades	3
Diameter, feet and inches	12—6
Pitch, (as set) mean, feet and inches	15—3
Pitch, adjustable, from feet and inches	14—6 to 16—6
Ratio of diameter to pitch	1.22
Area, projected, square feet	40.8
Area, helicoidal, square feet	49.4
Area, disk, square feet	122.7

There is one main condenser in each engine room, cylindrical in form, the important tube data being as follows:

CONDENSERS.

Number of tubes	4.085
Diameter (outside), inches	⅝
Thickness, B. W. G.	No. 16
Length between tube sheets, feet	12
Spacing (between centers), inches	15—16
Cooling surface, square feet	8,000

In the forward engine room there is an auxiliary condenser of 600 square feet cooling surface. There is also an auxiliary condenser for the dynamo plant, located in the dynamo room, having a cooling surface of 200 square feet.

FEED-WATER HEATERS.

There is a feed-water heater in each engine room, located on the discharge side of the main feed pumps, with 600 square feet of heating surface, composed of 679 ⅝-inch tubes.

BOILERS.

It should be particularly noted that the products of combustion leave at the back of the furnaces, and on their way to the uptakes make a double passage across the tubes. In the *Chester's* boilers only a single pass is made by the gases of combustion, which enter the tubes near the front of the boiler furnaces.

FORCED-DRAFT BLOWERS.

The closed fire-room system is used, there being six independent Sturtevant fans installed, two to each boiler compartment, 66 inches in diameter, 24-inch width at tips of blades, of the double inlet type, with 42-inch intakes. Each fan is directly driven by a double-acting, two-cylinder, simple, horizontal engine (6 by 6), with cranks at 180 degrees, the steam admission and emission for both cylinders being controlled by one piston valve.

Salem.—The *Salem* is driven by outboard-turning twin screws, the propelling machinery, consisting of two Curtis marine reversible impulse turbines, one on each shaft, designed to develop 8,000 brake-horsepower, at 350 revolutions per minute with 250 pounds (gage) steamchest pressure. The machinery is arranged in two watertight compartments, separated by an athwartship bulkhead, the starboard screw being operated by the forward turbine.

Each turbine has a pitch diameter of rotating wheels of about 120 inches (center to center of buckets), and for the ahead motion consists of seven stages; each wheel is fitted with three rows of buckets, except in the first stage, which contains four rows. For backing there are two stages, the wheels or rotors being mounted on the shaft in the same casing as the go-ahead stages.

Each turbine consists of a cast iron cylindrical shell (for strength, cast steel is used in construction of the casing of the two first stages), divided by dished cast iron or cast steel diaphragms into separate compartments or stages. The moving buckets are mounted on the periphery of separate wheels in each stage, and all wheels are secured to and carried by a hollow steel shaft extending the length of the turbines. Where this shaft passes through the diaphragms, bronze bushings are provided, with small clearances, in order to prevent appreciable steam leakage from stage to stage, and where the shaft extends through the heads carbon-packed gland boxes are fitted to prevent steam leaking out at the ahead end, or air leaking in at the back end. These boxes are supplied with live steam between carbon packing, which makes an effective seal against air leaking in at the back end, and which, unless checked, would cause the vacuum to be lowered. Gland-box packing, on the ahead end, is required to withstand the pressure existing in the first stage only, in order to prevent steam leakage into the engine rooms; and, as this pressure is never excessive, under any condition of operation, no serious practical difficulty arises in guarding against such leakage. A drain, or "leak off," from these gland boxes leads to the fourth stage. The ahead steamchest contains twenty expanding nozzle openings to the first stage wheel, seventeen of which are controlled by valves, the three remaining openings being without valves, and consequently always open. When in operation, sufficient nozzle valves are opened to give the desired speed, the throttle valve being left wide open in order to secure full pressure in the steamchest. Variation in speed within limits may be made by throttle-valve regulation, but usually this is accomplished by opening or closing of nozzle valves.

Steam chests are of separate steel castings attached to each turbine-casing head. The astern chest contains the same number of nozzles as the ahead chest, but only eight are provided with valves. In maneuvering, nozzle valves are left open and speed controlled by throttle valves.

TABLE III.—TOTAL STEAM CONSUMPTION FOR ALL PURPOSES (EXCLUSIVE OF LIFT PUMPS), AT SPEEDS FROM 10 TO 25 KNOTS.

Speed.	Steam used per hour (pounds).					Steam consumption in percentage, referred to Chester's 4-turbine combination as 100.				
	Birmingham.	Salem (second series).	Chester. Turbines in use.			Birmingham.	Salem (second series).	Chester. Turbines in use.		
			Six.	Five.	Four.			Six.	Five.	Four.
10 knots	34,000	44,000	43,200	45,500	46,600	73	94	93	98	100
11 knots	39,000	51,000	48,600	51,700	53,600	73	95	91	96	100
12 knots	44,700	58,200	54,700	58,100	61,200	73	95	89	95	100
13 knots	51,000	66,200	61,000	65,000	69,200	74	96	88	94	100
14 knots	58,000	74,700	68,200	72,300	77,700	75	96	88	93	100
15 knots	66,000	84,000	76,500	80,500	87,000	76	97	88	93	100
16 knots	75,300	94,200	86,500	89,500	97,000	78	97	90	92	100
17 knots	86,200	105,400	98,500	100,300	108,200	80	97	91	93	100
18 knots	98,600	118,200		111,400	120,000	82	98.5		93	100
19 knots	114,400	132,500		124,500	133,500	86	99		93	100
20 knots	134,000	150,000		138,500	148,500	90	101		93	100
21 knots	160,000	170,500		155,000	166,500	96	102		93	100
22 knots	192,000	195,000		173,500	187,000	103	104		93	100
23 knots	232,800	227,400			214,700	108	106			100
24 knots	285,500	273,000			254,800	112	107			100
24.5 knots		300,000			284,000		106			100
25 knots		329,000								

TABLE IV.—STEAM CONSUMPTION OF MAIN ENGINES AND TURBINES ONLY AT SPEEDS FROM 10 TO 25 KNOTS.

Speed.	Steam used per hour (pounds).					Steam consumption in percentage, referred to Chester's 4-turbine combination as 100.				
	Birmingham.	Salem (second series).	Chester. Turbines in use.			Birmingham.	Salem (second series).	Chester. Turbines in use.		
			Six.	Five.	Four.			Six.	Five.	Four.
10 knots	21,600	29,900	24,250	31,400	32,300	67	93	75	97	100
11 knots	26,200	36,100	30,200	36,900	38,900	67	93	78	95	100
12 knots	31,300	42,800	36,200	42,500	45,700	68	94	79	93	100
13 knots	36,900	50,000	42,500	48,800	53,000	70	94	80	92	100
14 knots	43,000	57,800	49,000	55,400	61,000	71	95	80	91	100
15 knots	50,400	66,700	56,200	62,800	69,800	72	96	81	90	100
16 knots	58,900	76,500	63,900	71,400	78,900	75	97	81	90	100
17 knots	68,800	87,300	73,900	81,100	88,900	77	98	83	91	100
18 knots	80,000	99,000	92,400	92,000	100,000	80	99	92	92	100
19 knots	94,500	112,000		104,200	112,000	84	100		93	100
20 knots	113,000	127,300		118,000	125,900	90	101		94	100
21 knots	136,500	145,200		133,000	141,800	96	102		94	100
22 knots	166,000	169,000		150.000	160,700	103	105		93	100
23 knots	203,200	199,000			184,500	110	108			100
24 knots	247,000	238,000			218,000	113	109			100
24.5 knots		261,800			244,000		107			100
25 knots		286.400								

First-stage nozzles are of the expanding type, for the steam in its passage to the first revolving wheel undergoes too great a drop in pressure to permit the use of the parallel-flow type, which latter is used for all other stages, the drop in pressure being much less. Diaphragm plates have openings cast in them to allow passage of steam through to the nozzles.

Drain pipes are fitted between each stage and the succeeding one, in order that condensed steam in any stage may pass to the next one of lower pressure. The exhaust chamber drains to the condenser, and the discharge is assisted by a small steam ejector. Generally, however, this ejector is used only in getting underway, being closed off when the turbines have assumed normal working conditions.

PROPELLERS.

Prior to the official government acceptance trials of the *Salem* the contractors fitted and tried four different sets of propellers. The design which gave the best results (cast solid), and which was finally used, has the following principal dimensions:

Number of blades	3
Diameter feet and inches	9—6
Pitch, feet and inches	8—8½
Ratio, diameter to pitch	1.09
Area, projected, square feet	36.8
Area, helicoidal, square feet	43.7
Area, disk, square feet	70.9

CONDENSERS.

Two exhaust pipes connect each main turbine to a cylindrical, horizontal surface condenser, located in each engine room. In connection with each condenser, there is installed one Blake vertical dry-air pump, having one steam cylinder and one air cylinder, each double acting, operating on the same crank with fly-wheel between the two cranks. There is also a centrifugal wet vacuum pump for each condenser, of the two-stage type, directly connected and driven by a small two-stage (27 inch) Curtis turbine.

Number of tubes (each condenser)	4,448
Diameter of tubes (outside), inches	⅝
Thickness, B. W. G.	No. 16
Length, feet and inches	13—2
Cooling surface, square feet (each condenser)	9,460
Diameter exhaust, inlets (2), inches	42

There is an auxiliary condenser in the forward engine room and a condenser for the dynamo plant, both of which are similar in size to those heretofore described for the *Birmingham*.

BOILERS, FEED-WATER HEATERS AND BLOWERS.

The size and location of boilers, feed-water heaters and blowers are the same as on the *Birmingham*.

the port inboard by the low-pressure (port) turbine and the intermediate-pressure cruising.

The turbines may be used in any of three ways in propelling the vessel: First, for speeds up to about 18 knots all six turbines are put in operation, since this combination results in a smaller quantity of steam being required than with either of the other two combinations. Steam is then admitted initially into the high-pressure cruising turbine, exhausts into the intermediate-pressure cruising turbine, and from the latter splits and is conveyed through separate pipes to each of the main high-pressure turbines. From these latter steam is exhausted into the low-pressure turbines, and finally into the condensers. Second, for speeds beyond the capacity of the six-turbine combination, and up to about 23 knots, the five-turbine combination is used. Steam is admitted initially to the intermediate-pressure cruising turbine, passing thence to the two main high-pressure turbines, and from each of them to the connected low-pressure turbine. The high-pressure cruising turbine revolves idly in a vacuum. Third, for highest speed only the four main turbines are used, steam being admitted initially to each main high-pressure turbine, exhausted into the low-pressures, and then into the condensers. Both cruising turbines revolve idly in a vacuum, or may be disconnected by means of shaft couplings. It is to be understood, of course, that the four-turbine combination may be used for any speed up to the full power, just as the five-turbine combination may be employed for any speed up to its limit.

COMPILED FROM SUMMARY SHEETS OF COAL CONSUMPTION TESTS.

Test No.	Main air pumps.		Wet vacuum pumps.	Dry vacuum pumps.	Augmenters.	Main circulating pumps.			Steam consumption of main condenser auxiliaries (exclusive of main circulating pumps).			Steam consumption of auxiliaries necessary to propulsion.—includes main condenser auxiliaries; forced-draft blowers; oil pumps: Salem, Chester.			Steam consumption of auxiliaries not necessary to propulsion.			Total steam consumption of auxiliaries.		
	Birmingham.	Chester.	Salem.	Salem.[a]	Chester.	Birmingham.	Salem.	Chester.	(a) Birmingham.	(c+d) Salem.	(b+e) Chester.	Birmingham.	Salem.	Chester.	Birmingham.	Salem.	Chester.	(n+q) Birmingham.	(o+r) Salem.	(p+s) Chester.
	a	b	c	d	e	f	g	h	k	l	m	n	o	p	q	r	s	t	u	v
1	2,220	3,550	958	2,600	1,971	985	1,230	800	2,220	3,558	5,521	5,705	7,963	9,006	8,018	6,978	5,899	13,723	14,941	14,905
2	2,400	2,600	974	2,636	2,032	1,060	1,560	1,160	2,400	3,610	4,632	7,696	11,951	9,314	8,157	6,190	5,006	15,853	18,141	14,320
3	2,970	4,850	1,099	2,598	1,890	1,460	3,360	1,900	2,970	3,697	6,740	13,930	20,412	15,680	7,244	7,184	5,641	21,174	27,596	21,321
4	4,540	5,500	1,662	2,585	2,291	2,050	3,380	3,585	4,540	4,247	7,791	35,883	40,532	30,840	3,578	3,584	3,215	39,461	44,116	34,055

COMPARISON OF ABOVE BASED ON BIRMINGHAM (AUXILIARIES) AS 100.

1	100	160	43	132	100	100	125	81	100	160	249	100	140	158	100	87	74	100	109	109
2	100	108	41	130	100	100	147	109	100	150	193	100	155	121	100	76	61	100	114	90
3	100	163	37	137	100	100	230	130	100	124	227	100	147	113	100	99	78	100	130	101
4	100	121	37	113	100	100	165	175	100	94	172	100	113	86	100	100	90	100	112	86

TABLE V.—STEAM CONSUMPTION OF AUXILIARIES IN POUNDS PER HOUR.

Chester.—The propelling machinery of the Chester, designed for a working steam pressure at the turbines of 250 pounds (gage) and about 507 revolutions per minute for the contract speed of twenty-four knots, consists of Parsons marine steam turbines, driving four independent shafts, each shaft being fitted with one propeller. The installation comprises six ahead turbines in all, two of which—the high-pressure and intermediate-pressure cruising—are for use at low powers in order to secure economy. There are also two backing turbines, located in each of the low-pressure casings, and it is to be observed that this arrangement permits reversal only of the two inboard shafts in maneuvering.

The outboard shafts are operated entirely by main high-pressure turbines; the starboard inboard by the low-pressure (starboard) turbine and high-pressure cruising turbine, and

In any of the three arrangements, increase or reduction of power is effected by throttling, though in the six-turbine combination a by-pass is fitted between the first and second expansion, which may be used, within limits, for this purpose. All maneuvering is done with the four main turbines only, and in event of either the six or five-turbine combinations being in use when a signal is received to go astern, a quick shift is necessary to cut out cruising turbines. This simply involves closing and opening proper valves, and need not require a greater interval of time than is usual in reversing machinery of the reciprocating type.

For the removal of water, all turbines have a connection to a system of drain piping leading to the main condensers. The outlet from each turbine is controlled by a valve which is always opened when warming up, and also on the cruising tur-

bines when underway in case these are not in use for propulsion.

Shaft gland boxes (twelve in all) are bolted to forward and after casing heads of each turbine. In order to prevent leakage a steam pressure of about 1 pound above the atmosphere is usually maintained in gland boxes when cruising, through a system of piping installed for the purpose.

The machinery is installed in two compartments, separated by an athwartship watertight bulkhead, the two cruising turbines, in addition to the starboard main high-pressure and low-pressure being located in the forward engine room. For the ahead motion the inboard shafts turn outboard, and the outboard shafts turn inboard.

The turbine cylinders are parted horizontally and the valves bolted together. The lower half is cast with extensions, box shaped forward and aft, for retaining the journal and thrust bearings.

Important data of turbine dimensions, stages, blading, etc., are shown below:

	Diameter of Rotor Drum.	Length of Rotor Drum.	Diameter of Cylinder for Each Stage.						
			1st.	2d.	3d.	4th.	5th.	6th.	7th.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
H. P. cruising......	60	36	60¾	61	61¼	..	..	..	.
I. P. cruising......	49	60.5	51¼	51⅞	52.5	..	..	..	..
Main H. P. (port and starboard)...	42	103.5	43¾	44.5	45.5	47	49	52	..
L. P. (port and starboard)..........	65	53⅜	70	72	75	79	79	79	79
Astern (port and starboard).......	50	43	51	52	54	54	54	..	..

Stages.	Expansions	Rows.	Heights.	Pitch.	Clearances.
H. P. Cruising.			Inches.	Inches.	Inches.
First....................	First.......	12	⅜	⅞	0.03
Second..................	Second.....	12	½	⅞	.035
Third....................	Third......	12	⅝	1	.04
I. P. Cruising.					
First....................	First.......	15	1⅛	1¼	.04
Second..................	Second.....	15	1 7-16	1¼	.04
Third....................	Third......	15	1¾	1 5-16	.045
Main High Pressure.					
First....................	First.......	12	⅞	1¼	.03
Second..................	Second.....	12	1¼	1¼	.035
Third....................	Third......	12	1¾	1 5-16	.04
Fourth..................	Fourth.....	12	2½	1⅜	.045
Fifth....................	Fifth.......	12	3½	1 7-16	.05
Sixth....................	Sixth.......	10	5	1 13-16	.05
Main Low Pressure.					
First....................	First.......	5	2½	1 5-16	.055
Second..................	Second.....	5	3½	1⅜	.06
Third....................	Third......	4	5	1 13-16	.07
Fourth..................	Fourth.....	3	7	1¾	.08
Do..................	Fifth.......	3	7	1 15-16	.08
Do..................	Sixth.......	4	7	2 5-16	.08
Do..................	Seventh.....	4	7	2 5-16	.08
Astern Turbines.					
First....................	First.......	6	½	1⅛	.045
Second..................	Second.....	6	1	1⅜	.05
Third....................	Third......	6	2	1⅜	.06
Do..................	Fourth.....	6	2	1½	.06
Do..................	Fifth.......	6	2	1½	.06

PROPELLERS (MANGANESE BRONZE, CAST SOLID).

Number of propellers..........	4
Number of blades (each propeller)..........	3
Diameter, feet..........	6
Pitch, feet..........	6
Ratio of diameter to pitch..........	1
Area, projected, square feet..........	17.02
Area, helicoidal, square feet..........	19
Area, disk, square feet..........	28.27

CONDENSERS.

The main condensers, one in each engine room, are located abreast the low-pressure turbines. They are cylindrical, of the surface-condenser type, and each is supplemented by a vacuum augmenter installed beneath the condenser. The augmenter consists of a steam siphon, drawing air from the main condenser and discharging it to the air-pump suction. The siphon discharge passes through a small surface condenser (which latter is supplied with circulating water by connection to the salt-water side of the main condenser), in order to condense steam of the siphon jet. The main air pump has a direct suction from the condenser through a pipe having a water seal, holding a head of water equal to the difference in pressure produced by the augmenter jet. It is figured that an increase in vacuum of approximately 1 inch of mercury results from the use of the augmenter.

There is one auxiliary and one dynamo condenser, located in the forward engine room and dynamo room, respectively, both similar and of the same dimensions as those previously described for the *Birmingham* and *Salem*.

The principal tube data of each main condenser are:

Number of tubes..........	5,630
Diameter (outside), inches..........	⅝
Thickness, B. W. G..........	No. 18
Length of tubes, feet and inches..........	10—0¼
Spacing (between centers), inches—Upper half..........	1 x 1⅛
Lower half..........	1 x 1
Cooling surface, square feet..........	8,999
Exhaust inlets (rectangular), feet and inches..........	3—9 x 4—6

FEED-WATER HEATERS.

A cylindrical feed-water heater, composed of 630 ⅝-inch tubes and containing about 600 square feet of heating surface, is located near the forward bulkhead of each engine room on the discharge side of the main feed pumps. The heating agency is steam from the auxiliary exhaust line, which enters the shell at the top, circulates around the tubes over a system of baffles, and drains through a trap to the main drain line. The tubes, through which the feed water passes on its way to the boilers, contain twisted brass trips, held in place by perforated plates over the tube sheets to retard the flow and thus insure efficient heating. A small air coil is fitted in the lower water chest, to prevent the heater from becoming air bound. This coil is connected to the inside of the heater shell, near the bottom, and drains to the main condenser.

TABLE VI.—COAL CONSUMPTION TESTS.

No. of test.	Approximate speed.	Duration of test in hours.	Birmingham.				Salem.				Chester.			
			Average pressure in fireroom in inches of water.											
			Number of boilers in use.	No. of fireroom.			Number of boilers in use.	No. of fireroom.			Number of boilers in use.	No. of fireroom.		
				1	2	3		1	2	3		1	2	3
1	10	96	3	......	......	0.694	4	......	0.325	......	4	......	......	......
2	15	50	8	......	0.546	.788	8	......	.407	0.418	7	......	......	......
3	20	98	12	1.227	1.214	1.174	12	1.57	1.58	1.554	12	......	......	[a]0.9
4	([b])	[c]24	12	5.077	4.942	5.807	12	5.08	4.84	5.11	12	3.03	3.03	3.03

TOTAL EVAPORATION PER HOUR—BLOWER STEAM—NET AVAILABLE STEAM.

			Total evaporation.	Blower steam.	Net available steam.	Total evaporation.	Blower steam.	Net available steam.	Total evaporation.	Blower steam.	Net available steam.
			A[d]	B[e]	(A-B)[f]	C[d]	D[e]	(C-D)[f]	E[d]	F[e]	(E-F)[f]
1	10	96	32,871	990	31,881	44,674	873	43,801	36,097	....	36,097
2	15	50	67,438	1,961	65,477	84,280	2,219	82,061	74,596	....	74,596
3	20	98	129,176	5,200	123,976	163,111	7,385	155,726	134,270	525	133,745
4	([b])	[c]24	271,545	18,493	253,052	293,103	24,820	268,283	314,161	6,510	307,651

PER CENT OF TOTAL EVAPORATION PER HOUR—BLOWER STEAM—NET AVAILABLE STEAM.

1	10	96	100	3	97	100	2	98	100	0	100
2	15	50	100	3	97	100	3	97	100	0	100
3	20	98	100	4	96	100	4	96	100	0.4	99.6
4	([b])	[c]24	100	7	93	100	8	92	100	2	98

[a] Forced draft used intermittently 50 hours.
[b] Maximum speed: Birmingham, 24 knots; Salem, 24.32 knots; Chester 25.08 knots.
[c] Birmingham discontinued this trial after twelve hours
[d] Total water evaporated per hour, in pounds.
[e] Steam used per hour by forced draft blowers, in pounds.
[f] Net available steam per hour, in pounds.

BOILERS.

The gases of combustion make but a single pass across the tubes in their exit to the up-takes. It is to be noted, further-

more, that, although the grate surface is the same in the boiler installations of all three vessels, the *Chester's* boilers contain but 32,040 square feet of heating surface, as against 37,992 square feet in the boiler plants of the *Birmingham* and *Salem*.

FORCED-DRAFT BLOWERS.

The system of forced draft used on the *Chester* is similar to that on the other scout vessels. It is of the closed fireroom type, there being two blowers (six in all) 84 inches in diameter for each boiler compartment. Each blower is driven by a vertical two-cylinder (5 by 5), simple double-acting steam engine, with one piston valve to each cylinder. The blowers are arranged in pairs near the fore and aft center line of ship, with a connecting shaft between each two fans, so that both fans run at the same speed, and in event of accident to one engine the remaining engine may be utilized to operate both fans.

MACHINERY WEIGHTS.

Weight of the propelling machinery, shafting, bearings and propellers is as follows:

	Tons
Birmingham (2 shaft reciprocating engine arrangement)	234.49
Salem (2 shaft Curtis turbine arrangement)	254.80
Chester (4 shaft Parsons turbine arrangement)	207.38

Weight per horsepower (the maximum power of main engines or turbines for two consecutive hours during either steam or coal consumption trials) is:

	Pounds.
Birmingham (16,134), per I. H. P.	32.55
Salem (18,070), per S. H. P.	31.58
Chester (20,004), per S. H. P.	23.22

The weight of appendages (auxiliaries) to the above propelling machinery, including main condensers, air pumps, circulating pumps and dry vacuum pumps or vacuum augmenters, is as follows:

	Tons.
Birmingham	45.13
Salem (fitted with dry-vacuum pumps)	67.63
Chester (fitted with vacuum augmenters)	58.19

The boilers, fittings, smoke pipes and up-takes weigh as follows:

	Dry.	Wet.
	Tons.	Tons.
Birmingham (12 Fore River boilers, 4 smoke pipes)	262.51	94.14
Salem (12 Fore River boilers, 4 smoke pipes)	262.61	94.24
Chester (12 Nomand boilers 4 smoke pipes)	272.70	307.01

Weight of boilers with fittings and water in pounds per square foot of heating surface is:

	Pounds.
Birmingham	13.10
Salem	13.09
Chester	17.64

The total weight of machinery installation, including propelling machinery and appendages, auxiliary machinery, piping, boilers and fittings, smoke pipes and up-takes, lagging and clothing, flooring, ladders and gratings, fittings and gear, stores, tools and spare parts carried on board, and pipes, etc., connecting to machinery not under the cognizance of the Bureau of Steam Engineering, is as follows:

	Dry.	Water.	Total.
	Tons.	Tons.	Tons.
Birmingham	760.82	53.15	843.97
Salem	853.85	55.11	908.96
Chester	735.87	64.82	800.69

The weight per horsepower (main propelling machinery only) of all machinery (wet) is:

	Pounds
Birmingham (14,134), per I. H. P.	117.18
Salem (18,070), per S. H. P.	112.68
Chester (20,004), per S. H. P.	89.67

RESULTS OF TESTS.

The data obtained from the different series of tests are voluminous, and for the complete details the reader is referred to the report itself, which may be obtained from the Navy Department. The principal result of the tests, however, have been summarized and condensed in the tables which are shown in Tables I.-VI.

CONCLUSIONS.

The following conclusions are based on results of tests described in this report:

Main Propelling Machinery.—Tables III. and IV. have been compiled from curves plotted, and show at a glance for the three vessels, respectively, the weight of steam required per hour for all purposes as well as the amount used by the main engines or turbines only for speeds from 10 to 25 knots, at knot intervals, together with a percentage comparison based on the *Chester's* four-turbine combination.

An examination of Table III. shows that, based on total steam used for all purposes (excluding lift pumps), the *Birmingham* is the most economical of the scout vessels up to (a) 20.6 knots (50 percent of designed power of main engines). Above that speed the *Chester*, using the five-turbine combination, becomes the most economical, and at (b) 21.6 knots the four-turbine combination is more economical than the *Birmingham's* reciprocating engine installation. Up to (c) 22.25 knots, the *Birmingham* is more economical than the Salem (second series of tests), but above this speed the *Birmingham* becomes the least economical of the three vessels. Due probably to excessive gland leakage, the *Chester's* six-turbine combination is less economical than the five-turbine combination above (d) 17.4 knots; the five-turbine combination, up to the limit of its speed, is invariably more economical than the four-turbine combination. The *Chester's* four-turbine combination is less economical than the *Salem's* installation up to (e) 19.45 knots, but more economical above that speed.

Based on steam used at various speeds per hour by the main propelling machinery only (exclusive of all auxiliaries) the figures above stated change but slightly. Using reference letters as in the previous paragraph, the figures become (a) 20.6, (b) 21.5, (c) 22.45, (d) 18.0, (e) 18.9.

Auxiliary Machinery.—Conclusions as to relative steam consumptions of auxiliaries, for accuracy of comparison, should be based upon close regulation of such machinery in accordance with actual requirements. The quantity of condenser cooling water required, to cite an example, is largely dependent upon sea temperature, and in consequence this becomes a controlling factor in speed of circulating pumps. Moreover, for each speed of vessel, under conditions existing at the time, there is a point of regulation which gives minimum steam expenditure for each auxiliary. On main (IV.) steam-consumption tests close regulation of auxiliaries was not attempted, but on coal-consumption tests every effort was made to reduce steam thus expended to a minimum. Comparisons therefore are based upon results of these trials as shown in detail in Table V.

The various auxiliary machinery installed on the three vessels may be classed arbitrarily under the following three heads: (1) Like auxiliaries whose steam consumption depends largely upon efficient condition of working parts and speed of operation, and which class includes a large percentage of the auxiliaries of the three ships. Steam expenditure for these auxiliaries should not be widely different under like conditions of use. (2) Main condenser auxiliaries. Disregarding steam used by main circulating pumps, it will be seen in Table V. that the *Birmingham's* condenser equipment required the least steam expenditure during all trials, except at full power, when

the *Salem* used 6 percent less. The greatest exenditure was on the *Chester*, indicating that the *Salem's* wet-and-dry vacuum pumps are less expensive in steam used than the *Chester's* augmenters and air pumps. It should be pointed out, furthermore, that with exception of circulating pumps, which are similar, the main condenser auxiliaries differ radically in type, which makes comparison of their steam expenditures desirable and important. (3) Forced draft blower installations: Based on steam consumption per hour per indicated horsepower, the *Chester's* equipment shows a variable gain in economy, as compared with the other two vessels, of percent at low powers (5 indicated horsepower), extending to 16 percent at high (35 indicated horsepower) powers.

PROPULSIVE EFFICIENCY.

Due to dissimilar propeller effciencies, it is obvious that comparison based on steam consumption of the machinery (either main or inclusive of all auxiliaries) per hoursepower would not indicate the relative economies of the three vessels with the same degree of accuracy as the steam used per knot. As illustrating this results of coal-consumption trials may be cited: For example, on trial No. 3 (about 20 knots) the average horsepower (shaft) of the main engines or turbines necessary to propel each of the three vessels, as recorded in Table O, is, *Birmingham,* 7,120.5; *Salem,* 6,883.3; *Chester* (five-turbine combination), 8,374.

BOILER INSTALLATIONS.

In order to effect a true comparison covering steam-generating appliances on the scout vessels it is essential to take into consideration not only boiler efficiencies, but, as well, expenditures of steam (forced-draft blowers) necessary in conjunction with service operation of the plants. Differences in boiler design have been pointed out, and it is to be noted that, due to tortuous passage of gases of combustion across heating (tube) surfaces of the boilers of the *Birmingham* and *Salem* higher fire-room air pressures must be maintained compared with the *Chester's* boiler installation to burn the same weight of coal.

The results of the tests show that under similar conditions as to air pressure there is a wide difference in the amount of coal consumed. It may be further pointed out, in this connection, that on 10 and 15-knot coal-endurance runs the *Chester* steamed under natural draft, while on the other two vessels with the number of boilers in operation forced draft was a necessity. It will be apparent, therefore, that comparison of steam-generating apparatus should be based upon percentage of available net output of steam, in addition to boiler efficiency, as recorded in Table VI, compiled from results of coal-consumption tests.

Regulation of Motor Boats.

An act to amend the laws for preventing collisions of vessels and to regulate the equipment of certain motor boats on navigable waters of the United States went into effect July 9, 1910.

The motor boats subject to the provision of this act are divided into three classes: First, those under 26 feet in length; second, 26 feet or over and less than 40 feet in length; third, 40 feet or over and not more than 65 feet in length.

The act provides that every motor boat in all weathers, from sunset to sunrise, shall carry the following lights, and during such time no other lights which may be mistaken for those prescribed shall be exhibited:

Every motor boat of class 1 shall carry the following lights:

First. A white light aft to show all around the horizon.

Second. A combined lantern in the fore part of the vessel and lower than the white light aft showing green to starboard and red to port, so fixed as to throw the light from right ahead to two points abaft the beam on their respective sides.

Every motor boat of classes two and three shall carry the following lights:

First. A bright white light in the fore part of the vessel as near the stem as practicable, so constructed as to show an unbroken light over an arc of the horizon of 20 points of the compass, so fixed as to throw the light 10 points on each side of the vessel, namely, from right ahead to 2 points abaft the beam on either side. The glass or lens shall be of not less than the following dimensions: Class 2, 19 square inches; Class 3, 31 square inches.

Second. A white light aft to show all around the horizon.

Third. On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the starboard side. On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of 10 points of the compass, so fixed as to throw the light from right ahead to 2 points abaft the beam on the port side. The glasses or lenses in the said side lights shall be of not less than the following dimensions on motor boats of Class 2, 16 square inches; Class 3, 25 square inches.

On and after July 1, 1911, all glasses or lenses prescribed for boats in Classes 2 and 3 shall be fresnel or fluted. The said lights shall be fitted with inboard screens of sufficient height and so set as to prevent these lights from being seen across the bow, and shall be not less than the following dimensions: On motor boats of Class 2, 18 inches long; Class 3, 24 inches long;

Provided, That motor boats as defined in this Act, when propelled by sail and machinery or under sail alone, shall carry the colored lights suitably screened but not the white lights prescribed by this section.

Every motor boat under the provisions of this Act shall be provided with a whistle or other sound-producing mechanical appliance capable of producing a blast of two seconds or more in duration, and in the case of such boats so provided a blast of at least two seconds shall be deemed a prolonged blast within the meaning of the law.

Every motor boat of Class 2 or 3 shall carry an efficient fog horn.

Every motor boat of Class 2 or 3 shall be provided with an efficient bell, which shall be not less than 8 inches across the mouth on board of vessels of Class 3.

Every motor boat subject to any of the provisions of this Act, and also all vessels propelled by machinery other than by steam more than 65 feet in length, shall carry either life-preservers, or life belts, or buoyant cushions, or ring buoys or other device, to be prescribed by the Secretary of the Commerce and Labor, sufficient to sustain afloat every person on board, and so placed as to be readily accessible. All motor boats carrying passengers for hire shall carry one life-preserver of the sort prescribed by the regulations of the Board of Supervising Inspectors for every passenger carried, and no such boat while so carrying passengers for hire shall be operated or navigated except in charge of a person duly licensed for such service by the local board of inspectors. No examination shall be required as the condition of obtaining such a license, and any such license shall be revoked or suspended by the local board of inspectors for misconduct, gross negligence, recklessness in navigation, intemperance, or violation of law on the part of the holder, and if revoked, the person holding such license shall be incapable of obtaining another such license for one year from the date of revocation: *Provided,* That motor boats shall not be required to carry licensed officers except as required in this Act.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

A Broken Bilge Pump Chamber Bottom.

It may be interesting to marine engineers to relate a simple repair which can be made to a broken bilge pump or feed pump chamber bottom. It sometimes happens that a hole is knocked in the metal of such a casting, either due to wearing action reducing the thickness and strength of the metal or to an originally faulty casting. This difficulty will usually show itself when the engines are racing in a heavy head sea, and, as a rule, not much leisure is available for an elaborate repair.

The trouble may, however, be remedied in either of the following ways: One method is to take a piece of rubber valve sufficiently large to overlap the hole, and to place this over in the pump chamber. A piece of flat iron plate should be put under this to support the rubber and give it stiffness,

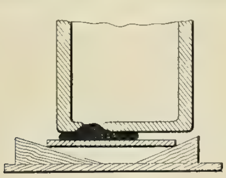


FIG. 1.

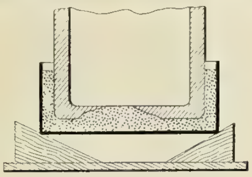


FIG 2.

and this plate can then be wedged up tight by means of wedges placed between it and the tank top or platform. The rubber expands up into the hole and forms a watertight plug, as shown in Fig. 1.

Another method which may be adopted, if it is possible to stop the engines, and there is not too much water about, is to get a meat tin or other receptacle which is sufficiently near the size of the chamber end to pass over it. About ½ inch of good Portland cement should be placed in the bottom of the tin, this cement being mixed rather stiff. The tin should then be slipped over the end of the pump chamber and shored up from the tank or platform, as shown in Fig. 2. If a sufficient amount of time is given for this quick-setting cement to become hard it will be found that a good sea-going repair job has been effected, which will be sufficiently strong to enable the boat to be brought to port. Charles De Groot.

Southampton.

Steering by Means of a Jury Rudder.

One of the accidents which may befall a small boat, such as a fishing trawler, when at sea, is the loss of the rudder, and as such an occurrence may happen when the boat is a considerable distance from shore it may result in much inconvenience, and even danger. It may therefore be interesting to narrate the steps which were taken in order to overcome such a difficulty in the case of a steam trawler about 150 feet long which lost its rudder when it was about 400 miles from any port. The repairs had, of course, to be executed by means of such material as was available on board the vessel, and this did not offer a very wide selection. A few planks of wood which were on board the boat were bound together so as to form a surface approximately equal to the superficial area of the lost rudder. To the center of the board, near to its top edge, a steel hawser about 10 feet long was attached, the other end being fixed centrally to the stern of the vessel. At the two outside edges of the board two other steel hawsers were led aboard to the winch, which, as installed on these boats, is placed near the stern, and has a double barrel. The bottom edge of the board was weighted by means of the lead weights used in the trawling nets, so that when placed in the water it hung vertical. It will be seen that when there was any way on the vessel the central steel hawser took the strain and the jury rudder was formed, while the angle of inclination of the rudder to the course of the vessel was adjusted by means of the auxiliary side hawsers operated from the winch.

It was found that this arrangement operated very well in practice, and the boat was brought safely to port over a distance of 400 miles. The only danger which could acrue from such an arrangement would be the possibility, in a heavy following sea, of the jury rudder being washed with violence against the stern of the vessel, but circumstances were favorable to this form of construction being used.

Observer.

A Broken Guide Shoe.

The friction which occurs on marine engines between the guide and guide plate is a somewhat serious matter in spite of careful attention to efficient lubrication, and quite a perceptible amount of horsepower is used in overcoming internal loss due to this cause. Considerable attention has, however, been paid in design, not only to reducing the superficial area of the guides to as small an amount as is consistent with safety, but also to introducing metals which have surfaces which are not so susceptible to the abrasion which occurs when steel rubs against steel. For this reason the guide shoes are sometimes fitted with horizontal bars of white metal, dovetailed into the steel castings; these bars projecting slightly above the surface of the casting. As a rule the dovetail is about ⅜ inch thick, while the total thickness of the steel shoe is from

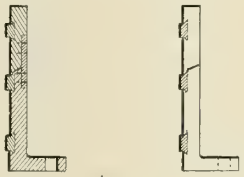


FIG. 1.

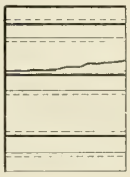


FIG 2.

1 inch to 1¼ inches. It is important that a very good factor of safety should be given in designing this depth, as will be evident from the following description of trouble occuring on such a guide shoe.

During bad weather, when a certain steamship was pitching and the engines racing badly, throwing great stresses on the guides, the shoe broke in two, as shown in Fig. 1. This was partly owing to the fact that the dovetail was made too deep and partly because a badly-fitting liner was placed behind the same. If these liners are not cut exactly the same size as the crosshead the latter will have a spring where the liner is not bearing. In this particular case the bottom half dropped into the oil-comb box, and on the next down stroke broke this away, dropping the piece of shoe into the crank pit. This made a rather difficult piece of repair work, inasmuch as there was now apparently no space on which to put a patch. The difficulty was, however, overcome as shown in Fig. 2. A recess

was cut in the metal of each of the severed halves of the guide shoe ¼ inch deep, the cut extending to about 2 inches on each side of the crank. Clearing holes were then drilled in the plate, and the shoe was marked off from these, tapping holes being then inserted in the guide. These holes were ⅜-inch clearing and tapping respectively. Muntz metal studs were then screwed in, leaving sufficient of the metal projecting for clinching. The plate was then tightened up and the studs riveted over so as to leave everything flush. The patched guide shoe was then replaced on the engine, and on trying the work the engine ran as if a new shoe had been used. S. R. S.

A Series of Mishaps.

Perhaps no saying is more correct with regard to "breakdowns," and especially minor accidents, than "Misfortunes never come singly," for the following five mishaps occurred on a vessel which I served in as third engineer in the early part of my sea-going career. At the time the vessel, which was a British tramp of the usual class at that period, was about 12 years old; she had been, and then was, engaged in the frozen meat trade between South America and England, we had three engineers on the main and two for the refrigerators, all being under the command of the chief of the main. The vessel had two boilers for the main engines, which were compound, and a smaller one for the freezing engine. The small boiler, however, was too small to drive that engine when exhausting on the atmosphere, and a donkey boiler was also fitted.

The following five mishaps occurred within a week; three taking place the first day, which, as is usual when breakdowns take place, was Sunday, and we were just about at the Equator, homeward bound.

Just before 8 A. M. the second engineer was surprised to find the engine-room bilges (there being no engine-room tank) rapidly filling with sea water; upon investigation it was found that the suction pipe for the cooling water to the freezing engine had "parted" from the main engine's injection pipe, to which it had been brazed as a cheap alteration when the freezing installation had been fitted.

As it was imperative that the freezing engines should not be stopped for longer than two hours, it was necessary to make a prompt repair; the freezing engine, I may say, exhausted into the main condenser, and, as the steam was generated in the small boiler, gave us an ample supply of fresh feed.

To keep the refrigerator running we gave steam from the starboard main boiler, and then commenced to repair the damaged pipe. Fortunately, about 18 inches above the topside of the injection pipe to which the suction pipe had been brazed there was a flange and another length of pipe. We simply fitted two wood "shores" in between the fore-and-aft girder on the ship's side to secure the pipe in its place, stopped up the holes in the bilge limber intercostals, wrapped the joint between the suction and injection pipes with white lead canvas and spun yarn, and buried the whole in Portland cement, which allowed us to work quite well until our arrival in Liverpool.

While we were engaged on the above repair we were surprised to hear the port boiler safety valve blowing off. Worse again, we found in spite of all coaxing we could not stop it. Our chief then decided to blow off the steam and examine the safety valve springs. As the freezing engine exhaust steam pipe discharged into the one waste steam pipe it was absolutely necessary to stop the machine, and being in the tropics, as well as on the boiler tops, it can be easily understood it was no soft job which fell to the lot of the "third." We examined the valve and springs, and, strange to say, found nothing wrong. Some pieces of dirt must have got under the valve when it first lifted, and had fallen back when the springs were being slackened. However, after closing up the valves and completing the pipe repair, we got under way about 3 P. M., all working very nicely after the fires got well under way.

About 8 P. M. the same Sunday we were again called out, as our old-time single-acting circulating pump ceased working satisfactorily. On examination we found the studs (⅞-inch brass) which held the foot valve in its place had come out of the cast iron ridge into which they were fitted. Parts of this ridge had crumbled away, and altogether the metal was too much deteriorated to fit new studs. Not only this, the foot valve itself, as well as the guards for the fiber valves, was broken into quite a number of pieces. It was decided that the best way to do was to try and dispense with a foot valve. This was done, and we got under way about 10 P. M.

Everything worked well until about Wednesday, I think, when, no doubt partly owing to being without a foot valve in the circulating pump, and mostly owing to the rotten condition of the injection pipe, the latter pipe burst in about the middle and was badly misshapen. It was so thin and tender it was almost beyond repair. This we rectified by tapping it in with a piece of wood into something like its former shape, wrapping it with several layers of canvas and wrapping it from end to end with flat-spun yarn, then we melted all the tallow we had, and poured it over the wrapping, smoothing it while hot with thin pieces of smooth wood. Our stock of Portland cement was exhausted, else we could have buried part of the pipe in cement; yet our repair held out until we reached Liverpool. This accident, of course, caused another stoppage of about four hours.

Finally, to crown all, on Saturday afternoon, shortly after dinner, a fireman asked me to go into the stokehold as steam was coming from under the stokehold plates at the end of the port boiler. This I did; and on examination I found it to be coming from the boiler, but exactly where it was hard to say. In accordance with standing orders I advised the chief engineer. As soon as he saw this development he, of course, at once ordered the steam to be blown off, fires drawn, and the boiler emptied. The boiler end was found to be in such a poor state that a chisel was easily knocked through. The method by which we repaired this was to take the largest piece of plate we had, which happened to be ⅝ inch thick; bend it to fit the radius of the boiler shell and also the shell and end; drill holes and mix red lead cement and leased out spun yarn together; cut holes with a round-nose chisel in the boiler end, and rejoint our plate in position. We then, fortunately, obtained from the deck department some old Portland cement they had stowed away and covered our repair with it. We then reduced our 80 pounds pressure to 45, and crawled home, where new half-end plates were put in both boilers. The circumferential seam at the end of this boiler had been cemented over some time, the cement having been displaced, and further deterioration taking place on the outside of the end plate, and doubtless owing to firemen throwing water on clinker and ash when cleaning fires caused this leak to show. Had it not been observed when it was, and promptly attended to, a very serious and probably a fatal explosion would have taken place. Third Engineer.

An Experience with a Broken Propeller.

An instance occurred where a propeller was broken while a vessel was leaving port for sea. The ship did not, of course, proceed to sea but remained behind for examination, but as there was no drydock or proper engineering appliances beyond the assistance of a small blacksmith's shop, the case was sufficiently rigorous. The blacksmith's shop was only available for making a few tools for the occasion. The accident occurred through the vessel swinging round on to the piles of a wharf owing to the breaking of the tow rope when the order to go ahead was given by the telephone. The starting

of the engines caused the propeller to strike the piles, with the result that it was broken, each blade having more or less metal taken off; two of the blades were broken off close to the boss.

The repairs were carried out by the engine-room staff, since there were no facilities at the port. The vessel had to be dipped by filling the forehold with water and by pumping the after ballast tanks out. It was perhaps fortunate that the ship was in ballast, having just discharged her cargo. Sufficient water was pumped into the forehold to bring the ship up by the stern and down by the head, and when the boss of the propeller was clear above the water pumping was stopped. In the meantime the last two couplings of the shaft were disconnected and the last length of shafting rolled out of its place. This made room for the tail shaft, which was drawn in to be surveyed.

Before this, however, the propeller had to be taken off, which involved some considerable time. A fire had to be lighted under the propeller boss in order to cause it to expand. Fouling keys and drafts were made for the occasion, and strong backs had to be cut and made to fit between the tail shaft coupling and the inside of the end of the stern tube. These strong backs were 4 inches in diameter. The fouling keys and drifts were driven behind the boss of the propeller, the fire being kept going for a day to get the boss hot. After a considerable amount of hard hammering with heavy hammers the propeller was in a position to be removed. This was, of course, held in slings from patent blocks swung over the ship's quarter. These were paid out and the propeller loaded into a punt or raft. The spare propeller was also hauled out of the hold and lowered onto the raft.

The lifting of the weights and the choice of tackle were subjects of rather special consideration, as very great care had to be exercised. The derricks were strengthened to lift the propellers, and everything was lifted with safety appliances adopted to prevent accident to life or property.

After the tail shaft had been drawn in, cleaned and examined, it was replaced, and the spare propeller lifted up by the patent blocks and entered on the shaft; the nut was then put on and tightened up, everything being carried out without a hitch in a satisfactory manner. T. W. Wilson.

Liverpool.

Broken Air Pump Head Valve and Repairs Effected.

Sometime since when on a trip from Cardiff to River Plate, and about half-way on our journey, a fearful rattle was heard suddenly in the air pump. The hot well was not overflowing, but the vacuum was going back. We stopped the engines and proceeded to overhaul the air pump. We found the head valve in about a hundred pieces; in fact, no piece was too large to go into an ordinary bucket. One could sarcely realize the complete collapse in so short a time without having seen the damage done.

Our method of repair was as follows: We obtained two pieces of 12-inch by 22-inch plank; cut two pieces the necessary length, and cut them in a circle the proper diameter to rest on the top of the air pump chamber. We secured the two pieces of wood together with long wood screws. We then cut two pieces of 1/8-inch iron plate the same diameter, cutting holes for water passages through bolts to secure the wood and iron plates, and also holes for bolts to secure the valves and guards and one in the center for the rod. We then bolted the whole together and got the carpenter to bore and cut holes through the wood to correspond with the holes in the plates.

We used 1/2-inch bolts to secure the plates and wood together and 3/4-inch bolts to hold the valves, which were spare ballast donkey india rubber valves about 5/8-inch thick. We cut up a piece of iron pipe for distance pieces, and some 1/8-inch Muntz metal discs were used and bolted hard down on the distance pieces, allowing about 1/16-inch play for the lift of the valves. We replaced this head valve, and then cut some washers to "line up" between the head valve and the neck on the air pump cover, and so jammed the head valve securely. This repair steamed us a distance of over 8,000 miles, and when taken out was as good as ever, and had worked without any trouble. Engineer.

How to Deal with a Split Smoke Tube.

A split smoke tube in a marine boiler is a very common occurrence even on board a ship which has only just been put into commission, and it is needless to say that when this happens a very considerable loss may result in delay to the ship and in increased consumption of coal. So much is this recognized that a good many boats carry patent tube stoppers, and when these are available the trouble is very simply overcome. Some engineers, however, on board vessels which are not so excellently equipped have not these facilities at hand, and even supposing that there was sufficient gear on board to enable the engineers to make a proper tube stopper it would occupy at least a few hours to do it.

For this reason it may be interesting to detail an old plan, and yet a very good one, which not every engineer knows about, in order to stop trouble due to this cause in a rough-and-ready manner. When such a tube splits, the first thing to do is to take a piece of soft wood, slightly less than the diameter of the tube. The wood should be about 3 inches long, with a recess in the middle of it about 1 inch less in diameter, and about 1 inch in length. The next step is to locate the position of the leaking part of the tube. This can be done by slowly pushing a piece of broomshank along the leaky tube until there is a change in the sound of the hissing noise made by the escaping steam. This will indicate that the end of the broomshank has just reached the leak, and that the steam is playing upon it. After finding the distance along the tube, the piece of wood, which has been prepared, should be pushed in until the recessed part is under or about the leak. It will be found that after a few hours' running the soft wood will swell, owing to the presence of the steam, and the leak will salt up. When this occurs a temporary repair will have been effected.

In the meantime it may be advisable for the engineer to make some tube stoppers in the following way: A length of iron, 7/8 inch or 3/4 inch in diameter, should be taken, a rake handle or slice bar will do quite sufficiently well. The ends of the bar should be threaded about 6 inches down, leaving a square at one end, which will be kept to the front of the boiler for holding on to in case the bolt turns when the stopper is being put into position. Four iron washers should then be made, of a diameter slightly less than the diameter of the tube; and between each pair of these washers, which are placed at the ends of the bar, must be fitted a rubber washer, made from circulating or air-pump valves, for the purpose of being squeezed out to the size of the tube. Between the washers at each end another piece of tube of any convenient size should be placed to act as a distance piece. This tube stopper should be placed into the tube past the leak with all washers in position, and screwed up from the front until the expansion of the rubber washers makes a tight joint. A variation on this practice, which is sometimes used by engineers who do not think that a rubber washer is sufficiently durable, is to use a lead washer in place of the rubber; but the principle is the same, and in practice the above-described repair is found to be extremely useful in emergency.

Apprentice.

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Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Shipbuilding.

Some indication of the trend of shipbuilding is afforded by two reports which have just come to hand. One of these is the yearly shipbuilding report for the fiscal year ending June 30, 1910, issued by the Bureau of Navigation, Department of Commerce and Labor of the United States, and the other is the quarterly report from Lloyd's Register for the quarter ended June 30, 1910.

According to the Bureau of Navigation report, during the year ended June 30, 1910, there were built in the United States and officially numbered by the Bureau of Navigation 1,502 merchant vessels of 347,025 gross tons compared with 1,362 of 232,816 gross tons during the fiscal year of 1909, showing a substantial increase of 114,209 gross tons, or 49 percent. Forty-four steel steamships, aggregating 82,333 gross tons were built on the Atlantic and Gulf coasts, as compared with 23 ships of 28,613 gross tons in the previous year, making an increase of about 190 percent. Similarly, the steel steamship tonnage built on the Great Lakes advanced from 36 ships, aggregating 88,426 gross tons in 1909, to 47 ships aggregating 146,896 gross tons in 1910, an increase of 58,470 gross tons, or 66 percent. On the whole, therefore, shipbuilding in the United States has shown a very marked and encouraging advance, particularly in the coast yards. Although many inquiries for new tonnage have been received during the last few months, comparatively little new business has been closed recently, and the prospect of the increased activity becoming permanent is none too bright. Practically all of the new construction is for coastwise trade.

On turning to the quarterly returns of Lloyd's Register, we find that excluding warships, there were 394 vessels of 1,118,587 gross tons under construction in the United Kingdom at the close of the quarter ended June 30, 1910. The tonnage now under construction is about 61,000 tons more than that which was in hand at the end of last quarter, and exceeds by nearly 373,000 tons the total building twelve months ago. The figures of the warship tonnage now being built, which amount up to 378,523 tons displacement, are the largest reported since June, 1901. The Belfast and Glasgow districts show the greatest activity, although nearly every important shipbuilding center shows the same substantial advance over the amount of work in hand for the same quarter of the previous year.

After the extremely low returns which have been reported by Lloyd's during the years of 1908 and 1909, the present activity is very encouraging, especially as there does not seem to be any immediate prospect of its ending. On the whole, the situation in the shipbuilding industry, as far as the construction of new tonnage goes, is far more encouraging to-day than it has been any time during the past two years, although, of course, compared with the great volume of business in hand five years ago, these figures are by no means startling.

The New Bureau of Lighthouses.

Sweeping changes in the administration of the United States Lighthouse Establishment were inaugurated recently by the enactment of a law creating a Bureau of Lighthouses, headed by a Commissioner of Lighthouses, to perform the duties and exercise the power and authority previously held by the Lighthouse Board. This change is in accordance with the method of managing most of the departments which come under the administration of the Secretary of the Department of Commerce and Labor, and should prove a satisfactory and efficient solution to the problem of caring for the lighthouse establishment. The bill provides not only for a Commissioner of Lighthouses, but also for a Deputy Commissioner, both of whom are to be appointed by the President, also for a Chief Clerk, Inspectors, Clerical Assistants, and other employees necessary to carry on the business of the department. Two other important officers are provided

for, one of which is the Chief Constructing Engineer and the other the Superintendent of Naval Construction, both of which positions are to be filled by appointment by the President. The former carries a salary of $4,000 (£823), per annum and the latter, $3,000 (£615) per annum. The new Commissioner of Lighthouses is authorized, subject to the approval of the Secretary of Commerce and Labor, to rearrange the ocean, gulf and lake coasts, and the rivers of the United States, Porto Rico and the naval station in Cuba into not exceeding nineteen lighthouse districts, and a lighthouse inspector is to be assigned in charge of each district. These inspectors are to receive a salary of $2,400 (£493) a year, except the inspector of the third district, whose salary is to be $3,600 (£740) a year. At the discretion of the President, army and navy officers may be appointed to act in place of civilian inspectors for the next three years, if it seems desirable.

This reorganization of the Lighthouse Department will undoubtedly result in increased efficiency in the maintenance of this important branch of federal activity, and mariners can rest assured that nothing which can be done will be left undone to safeguard navigation in American waters.

Torpedo Boat Destroyers.

An article in this issue on modern torpedo boat destroyers, calls attention to the relative number of such vessels owned by the leading naval powers, and from this comparison it is evident that while almost without exception the number of destroyers in any navy bears a fixed relation to the number of capital ships in the navy, yet there is one exception, and that is the United States, which is undeniably weak in this branch of naval service.

The characteristics of the modern destroyer are thoroughly discussed in the article to which we refer, and it is pointed out that the tendency is in the direction of higher speeds, larger displacements and a greater radius of action. These features have been developed in order to enable the destroyer to remain at sea with a battleship fleet and to cope with the swift torpedo vessels of the enemy. That this development has been due almost entirely to the introduction of such engineering features as steam turbines, small diameter watertube boilers fitted for burning oil, forced draft, forced lubrication, etc., is well known, and it is principally to such refinements in design that we must look for improvement in the future. Unless the destroyer becomes an armored vessel, it is doubtful if the size is ever increased more than is absolutely necessary to secure the necessary speed and steaming radius. But that marked improvement in design of such a vessel can be made without material increase in size has been shown only recently by the construction of the *Paramatta* for the Commonwealth of Australia. This vessel, designed by Professor Biles, is of practically the same dimensions as the modern British destroyers, but it has about 10 percent less displacement. In spite of this, she carries about a third more oil fuel than the Admiralty designed boats. The designed speed of the British destroyers is 27 knots, while that of the Australian vessel is 26 knots. On trial, however, she developed a maximum of 28.28 knots, and this result was obtained without forcing the boilers. At a cruising speed of about 14 knots, it has been shown that the fuel consumption of the vessel will admit of 20 percent greater steaming radius than the contract called for. The excellent results achieved with this design, simply indicate what can be looked for when the exigencies of the case demand a greater speed and greater steaming radius from this type of vessel.

Comparative Backing Trials of Scout Cruisers.

In connection with the summary of the comparative steam and coal consumption trials of the United States scout cruisers *Salem, Birmingham* and *Chester,* which is published elsewhere in this issue, it is of interest to note the result of comparative backing trials that have been carried out with these same vessels. These latter tests were made to gain information regarding the tactical features involved in the three modes of propulsion, since with reciprocating engines a backing power about equal to the ahead power is afforded without any increase in weight except that of the backing eccentrics, rods and links. With turbines, however, backing power requires additional turbines with a considerable increase in weight. Former practice has been to provide a backing power of about 50 percent of the ahead power, although as a matter of fact the backing power usually is rather less than 40 percent of the ahead power. The results obtained from the tests on the three scout cruisers showed that at all speeds the reciprocating engine provides better backing power than the Curtis turbines, and that the latter is superior to the Parsons turbine. The average time required for reversing was, for Parsons turbines, 8.2 seconds; for Curtis turbines, 39.2 seconds; for reciprocating engines, 5.1 seconds; and the average drop in boiler pressure was, for Parsons turbines, 82.4 pounds; for Curtis turbines, 75.8 pounds; and for reciprocating engines, none. In fact, in the case of the *Birmingham,* the average boiler pressure at the end of the backing interval was 1.5 pounds greater than at the beginning of the interval. The advantage of the reciprocating engine over the Curtis turbine and of the Curtis turbine over the Parsons turbine, increases slightly as the speed increases, although the proportion based upon the distance head reached by the vessel during the interval required to bring her dead in the water from a given speed ahead is practically constant.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		June 1.	July 1.
Florida	20,000	20¾	Navy Yard, New York.......	66.3	68.8
Utah	20,000	20¾	New York Shipbuilding Co....	76.0	80.0
Arkansas ...	26,000	20½	New York Shipbuilding Co....	27.6	34.6
Wyoming ..	26,000	20½	Wm. Cramp Sons............	22.5	28.4

TORPEDO-BOAT DESTROYERS.

Paulding ...	742	29½	Bath Iron Works............	89.4	92.4
Drayton	742	29½	Bath Iron Works............	82.5	86.1
Roe	742	29½	Newp't News Shipbuilding Co.	88.7	92.3
Terry	742	29½	Newp't News Shipbuilding Co.	86.9	89.7
Perkins	742	29½	Fore River Shipbuilding Co...	79.6	86.8
Sterrett	742	29½	Fore River Shipbuilding Co...	77.1	83.8
McCall	742	29½	New York Shipbuilding Co....	76.5	85.4
Burrows	742	29½	New York Shipbuilding Co....	72.7	85.2
Warrington..	742	29½	Wm. Cramp & Sons..........	68.3	74.4
Mayrant	742	29½	Wm. Cramp & Sons..........	73.9	79.1
Monaghan ..	742	29½	Newp't News Shipbuilding Co.	19.9	26.7
Trippe	742	29½	Bath Iron Works............	38.8	49.9
Walke	742	29½	Fore River Shipbuilding Co...	32.1	39.1
Ammen	742	29½	New York Shipbuilding Co...	40.4	48.5
Patterson ...	742	29½	Wm. Cramp & Sons..........	23.0	33.0

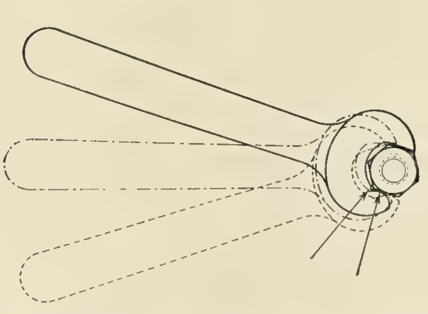
SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co..	94.7	97.4
Seal	...	..	Newp't New Shipbuilding Co.	50.1	51.2
Carp	...	..	Union Iron Works..........	53.5	58.6
Barracuda ..	...	..	Union Iron Works..........	53.5	58.6
Pickerel	...	..	The Moran Co..............	50.4	53.1
Skate	...	..	The Moran Co..............	50.4	53.1
Skipjack	...	..	Fore River Shipbuilding Co...	40.1	45.3
Sturgeon ...	...	..	Fore River Shipbuilding Co...	38.9	43.7
Tuna	...	..	Newp't News Shipbuilding Co.	26.2	28.3
Thrasher ...	...	..	Wm. Cramp & Sons..........	5.7	6.4

ENGINEERING SPECIALTIES.

Williams Rachet Wrench.

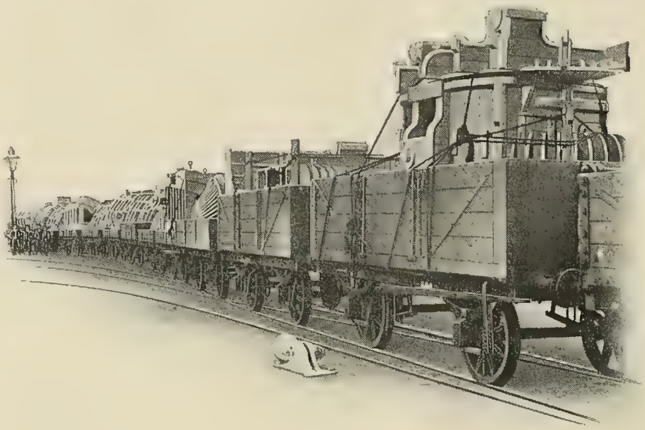
J. H. Williams & Company, Brooklyn, N. Y., have just placed on the market a new drop-forged wrench, which is practically a ratchet wrench without any ratchet mechanism. It is claimed that it will do anything that any other drop-forged wrench can do, and do it with imperceptible wear on the nut or tool. The principle involved in moving any nut, set screw, etc., with a wrench is two points of contact. The designer of this wrench



appreciated this fact, and cut out the useless end of the ordinary wrench, producing a tool with a reciprocating action which promises to revolutionize the use of drop-forged wrenches. It is not necessary to lift the tool from each side of the nut, as is done with an ordinary wrench, but the action is progressive and rapid, making the tool a timesaver. No pawl or other mechanism is necessary, since turning over the tool enables either right or left-hand adjustment of the nut.

Interesting Shipment of Turbine Patterns.

We show herewith a photograph of a large consignment of turbine cylinder patterns, which were made by David Brown & Sons, Huddersfield, for the Cunard express steamer *Lusitania.* The *Lusitania* was built on the Clyde, and as the patterns

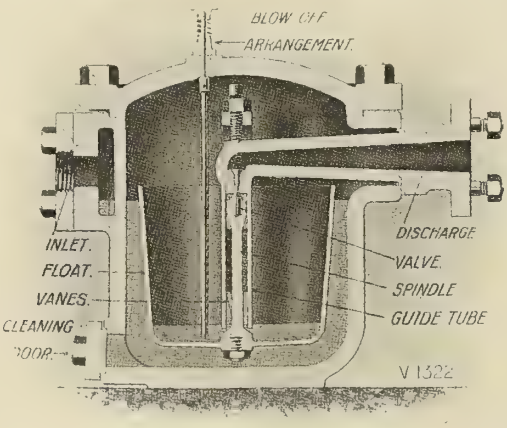


were too large in diameter for railway transit they had to be made in quarters dowelled together. About 11¼ standards of 2 inches diameter were used, and some 7,500 hours spent on these patterns.

The Sentinel Steam Trap.

The Sentinel steam trap, made by Alley & MacLellan, Ltd., Sentinel Works, Glasgow, automatically regrinds its valve after each discharge. This feature, it is claimed, preserves its tightness with gritty steam. The trap has only one moving part, which, as shown in the illustration, is the float to which is attached the spindle, guided in the vertical tube by spirally-formed vanes and having on its point a valve. The float is free to rise or fall or to rotate.

In action the chest fills with water, which overflows into the float, filling it up and sinking it. In sinking, the float opens the valve through which the water is discharged by the steam pressure, and thus lightened the float rises, again closing the outlet.

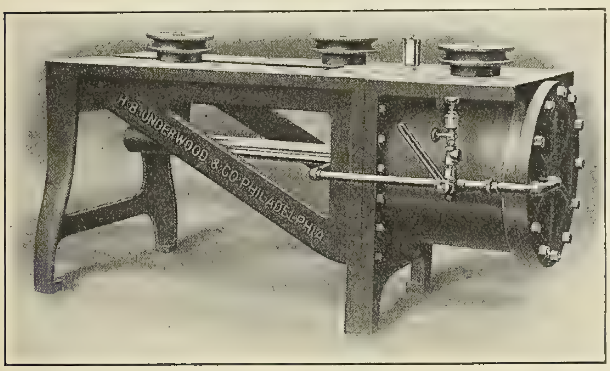


It is pointed out that the float must sink at once, and that when closing the valve acts as a check valve. It is claimed, therefore, that the trap cannot balance and the action cannot generate into a dribble. It is claimed that during the discharge the float is revolved practically without friction by the impingement on the vanes of the water flowing up the guide tube. This radial motion attains its maximum speed as the valve is about to shut, and by the fly-wheel action of the rim of the float the valve is reground each time the trap acts. Any

roughness on the valve faces caused by grit is thus burnished over and remedied almost as soon as it occurs, thus keeping the trap tight indefinitely.

New Underwood Pipe-Bending Machine.

The pipe bender which is shown in the accompanying illustration has been placed on the market by H. B. Underwood & Company, 1025 Hamilton street, Philadelphia, Pa., and besides being efficient for the bending of pipes may also be employed as a bulldozer and power bender. The length of stroke is 15 inches, and the control very flexible. The rectangular work table is of ample dimensions, and numerous holes are provided for conveniently locating dies and pins. No obstruction that will interfere with the work in any way is presented by the top of the table, as it is perfectly flat. The large number of dies which are ordinarily required for bending a great variety of pieces is avoided, as simply changing the position of the resistance studs permits varying the shapes at will. The ram, located beneath the table, slides in a strongly constructed guide, and is provided with a stud projecting above the table on which a roll of suitable size may be placed. Steam or compressed air may be used to operate the machine, and for the former a



metallic packing is used on the piston rod and for the latter a leather packing. The use of compressed air has many advantages over the use of steam, and the maker recommends it as a motive power when available. The diameter of the cylinder is 20 inches, and the supply of working fluid admitted to the piston is the only limit placed on the power of the machine.

A special feature that is very advantageous and worthy of particular attention is that the piston has air on both sides of it at all times. Because of a special construction of the operating valve only the amount of working fluid required for actual bending is wasted, as it is transferred from one side of the piston to the other, and the piston is forced forward because that side offers a larger area than the other, which is smaller because of the space occupied by the piston rod. Thus the piston can be moved only a fraction of an inch when necessary, or it may be held perfectly stationary for measuring the work. Such a precise control is desirable in all sorts of bending work and is particularly useful in straightening bent pieces.

Reno Inclined Truck Elevator.

The illustration shows one of several installations of the Reno inclined truck elevators which the Reno Inclined Elevator Company, of New York, have made on steamship docks. This method of conveying trucks is entirely new, and the simplicity of the design and economy in first cost will appeal to the superintendents of docks, warehouses and other situations where loaded trucks are to be conveyed up and down an incline. The machine illustrated is in use at the Pequonnock Dock, Bridgeport, Conn., owned by the New York, New Haven & Hartford Railroad Company. It consists of an endless steel chain provided with special projections which engage the axle of the truck. This chain is supported by and slides in a lubricated steel channel, and is kept in continuous motion by a sprocket wheel at either end driven by an electric motor and reduction gearing, the motor being located in a box on the floor of the freight house shown in the lower right-hand corner of the picture, and driving a shaft under the floor to which the sprocket wheel is keyed. It is claimed that the machine is under perfect control of the attendant, and can be started, stopped and reversed by turning a switch. It will be noted that the truck wheels carry the load, the chain simply engaging the axle and thus pulling the truck up the incline. It will also be

noticed that the men walk up the incline with their feet on opposite sides of the narrow partition, 4 inches wide. An important feature claimed for the machine is its perfect safety to the workmen, as there is no moving platform, which require great care from those who are using them in order to prevent the feet from being caught. The speed of the moving chain is 100 feet per minute, at which rate it will deliver 960 trucks per hour. A 5-horsepower motor runs the conveyor. The apparatus can be designed to be lowered out of sight and the slot covered with a steel channel. This is also a very important feature of this machine, as in this position the surface of the platform is unobstructed and can be used by the workmen for loading and unloading freight when the incline is almost level and the truck elevator is not necessary. The chain and sprocket wheels are attached to a steel truss which is pivoted at either end, and by means of a powerful screw and a suitable handle one man can lower or raise the machine into position in a few seconds.

PERSONAL.

Chief Constructor W. L. Capps, whose resignation as the chief of the Bureau of Construction and Repair will take effect in October, expects to leave Washington early in August on an inspection trip which he had planned some weeks ago. Naval Constructor Richard M. Watt, who has been on duty as construction officer at the Norfolk navy yard, will go on duty in the Bureau of Construction and Repair in anticipation of succeeding to the office of chief constructor in October.

TECHNICAL PUBLICATIONS.

The Naval Pocketbook. 1910. Edited by Rollo Laird Clowes. Size, 3½ by 5 inches. Pages, 1,032. Numerous illustrations. London, 1910. W. Thacker & Company. Price, 7/6 net.

Of all the naval annuals which are published this is probably the most concise and convenient for ready reference, since the information is given in a semi-tabulated form and the volume is published in pocket size. There are no new features in this edition, but the book has been carefully revised and corrected to March 14, with addenda to May 6, 1910. The contents include a classification of ships, a comparative summary of the fighting fleets, a classified and analytical list of the navies of all nations, complete information regarding the guns and small arms of the various nations, a table of the latest rifles of States possessing navies, notes on torpedoes, naval personnel and comparative rank and retiring ages in European navies, notes on navy estimates, details of the world's drydocks, trial trip tables, and the usual plans of battleships and cruisers of the various navies, showing the location and extent of armor and gun emplacement.

Jordan's Tabulated Weights of Iron and Steel. Sixth edition. By Charles H. Jordan, M. I. N. A. Size, 5 by 3⅛ inches. Pages, 640. Numerous illustrations. London, 1909: E. & F. N. Spon, Ltd., and New York, 1909: Spon & Chamberlain. Price, 7/6 net.

The new edition of this well-known work is necessitated in part by the alterations which have recently been made in the rules of *Lloyd's Register of Shipping* by the adoption of a decimal system in denoting the thicknesses of various sections of steel to be used in the building of vessels for classification in this society. This alteration has necessitated the production of a series of tables of weights and sectional areas in accordance therewith. These tables have, therefore, been added to the present edition, and they are based upon the British standard ship sections as drawn up by the Engineering Standards Committee and approved by Lloyds.

The volume includes tables of weights of iron and steel plating and sections of various standard gage thicknesses and diagrams and sectional areas of various iron and steel shapes; weights and sectional areas of steel in thicknesses of twentieths and fortieths of an inch; weights and sectional areas of steel in thicknesses of thirty-seconds of an inch; equipment weights for all classes of vessels; tables of decimal equivalents of the foregoing; tables of equivalent weights and measures in metric and British units, and finally the additional tables of weights and sectional areas of steel sections contained in Lloyd's Rules, based upon the British standard sections in thicknesses of fiftieths of an inch and also decimal equivalents, etc.

Board of Trade Arithmetic for First and Second Class Engineers. By Peter Youngson. Size, 4½ by 7⅛ inches. Pages, 332. Numerous illustrations. Glasgow, 1910: James Munro & Company, Ltd. Price, 5/ net.

Candidates for Board of Trade examinations for first and second class engineers will find this book of great value, since it gives several sets of examination papers, with complete solutions to the problems worked out in detail, showing each step and all of the numerical computations. In the introduction the author calls attention to two important points which deserve emphasis. One is the precision which should be aimed at in the solution of these problems. He shows how ridiculous it is to attempt to work out problems to four or more decimal places when the data given has been got with instruments in which there is opportunity for error as great as 5 percent. As practical men, engineers should use practical methods and have a comprehensive idea of the value and precision of the results obtained by these methods. For instance, it is a waste of time to calculate the indicated horsepower of an engine from diagrams to, say, two decimal places when the indicator has in all probability an error of 5 percent either way, so that the actual indicated horsepower of the engine may vary by 50 or 100 horsepower. The second point to which he calls attention is the necessity for indicating in the solution of problems the various steps by which the final result is reached, so that the method as well as the actual computation is clearly indicated.

The first few pages of the book explain the various arithmetical computations which it is necessary to know to solve the problems. A set of second class examination papers is then given, which is immediately followed by the complete solution of each problem separately. This is followed by a second set of second class examination papers to which merely the answers of the problems are given. Similarly, two sets of first class examination papers are given, for one of which complete solutions of the problems are worked out while for the other simply the answers are given.

Ship Construction and Calculations. By George Nichol. Size, 6½ by 9¼ inches. Pages, 330. Figures, 239. New York, 1910: D. Van Nostrand Company. Price, $4.50 net.

This book was reviewed in our February, 1910, issue, as received from the Glasgow publishers, James Brown & Son. The American edition does not differ from the English edition.

Lloyd's Register of American Yachts, 1910. Size, 9 by 7 inches. Pages, 456. Colored plates, 48. New York, 1910: *Lloyd's Register of American Yachts.* Price, single copies, blue coth, gilt edges, $8.50; canvas, plain edges, $7; subscription prices, $7.50 and $6.

This volume, which makes its appearance for the eighth successive year, is unchanged in its appearance from last year, but an inspection of its various departments discloses good grounds for the claim of the publishers that it is necessary to make the book entirely new every year. The changes in the 3,500 entries of the yacht list proper show a complete reorganization of the American pleasure fleet on a new basis, the gasoline engine displacing rope and canvas more rapidly than in any previous year. With but three new additions to the sailing fleet there are to be noted many omissions of famous yachts, schooners and cutters sold for commercial service or broken up. Of the older and larger sailing vessels still left the great majority are now auxiliaries. The new auxiliary bark *Aloha,* 218 feet over all, with a gross tonnage of 659, stands alone among the new yachts of the year. Next in importance to her in the way of additions to the list are the cruising power yachts of from 80 to 100 feet, of a type which combines good cruising speed with sea-going qualities. In this connection another interesting change is to be noted, namely, the removal of steam-propelling machinery from some of the older yachts and the substitution of gas engines. An entirely new type that is found in the *Register* this year for the first time is the ocean cruiser of about 60 feet length, the product of the long-distance ocean races of recent years to Bermuda and Havana.

The most numerous additions to the yacht list are found in the new type of raised-deck power cruisers of from 30 to 60 feet over all. Of purely racing types, the majority are found in such small sailing yachts as the *Sonder* class and *Seawanhaka* cup class, and in the 40-foot class of full-powered launches.

One notable feature is the increase in the number of clubs, the total being 458, as compared with 159 in the 1905 *Register.* This increase is made up in part of the conventional yacht clubs, but largely of clubs whose membership is specially devoted to power yachting. The commercial value of this side of yachting, as represented in engine building and allied industries, cannot be estimated. The incidental features of the book include the usual list of yacht owners, the flags and colors of all the clubs, and of 2,047 individual yachtsmen, a list of thirty-one yachting associations, a list of the late names of yachts, signal letters carried by yachts, etc.

Sea Power and Other Studies. By Admiral Sir Cyprian Bridge, G. C. B. Size, 5 by 7 inches. Pages, 311. London, 1910: Smith, Elder & Company. Price, 5/– net.

Admiral Bridge has spent a lifetime in the service, and since he entered the navy in 1853 he has been a careful observer. Therefore he is well qualified to turn his experience and observation to good service in his writings. The present volume is a collection of a dozen essays written during the past few years for leading magazines. They are of permanent interest, and will serve to correct some accepted and erroneous conclusions. The historical studies dealing with "Facts and Fancies About the Press Gang," "Projected Invasions of the British Isles," "Queen Elizabeth and Her Seamen," and the two studies on Nelson and Trafalgar, particularly the one which deals with "Naval Strategy and Tactics at the Time of Trafalgar," are of special interest. The latter is the substance of a paper read before the Institute of Naval Architects. The two fine essays on "Sea Power" and the "Command of the Sea," which are to be found in the Encyclopædia Britannica, are included. Both of these are too well known to be commented upon. The whole volume is of the highest value, and constitutes a valuable addition to naval literature.

QUERIES AND ANSWERS.

Questions concerning marine engineering will be answered by the Editor in this column. Each communication must bear the name and address of the writer.

Q.—Please explain the construction and operation of the type of boiler feed pump used on American river steamboats known as the "Doctor." Also state the reasons for its use in place of ordinary feed pumps and injectors. A. B. SEARS.

A.—The "Doctor" type of feed pump to which you refer was designed to give a steady supply of feed water to boilers under all conditions of steam pressure and with sandy or muddy water. It consists of a vertical beam engine with crank and fly-wheel operating four pumps. Two of these are simple lift pumps, drawing water from the river and discharging it into an open feed-water heater at the top of the apparatus. The other two pumps are feed pumps taking their supply from the heater and forcing the water into the main boilers. Each force and suction pump is usually designed to have ample capacity to feed the entire battery of boilers, so that in case of accident any one of the pumps may be disconnected for repairs without interrupting the service.

The base plate upon which the various details are erected is deep, and contains numerous ports and passageways, which form the water connections between the various parts of the pump. The suction pipe from the river or hot well, as the case may be, is connected with a vacuum chamber, and connects through a passage in the base casting with the suction side of the two lift pumps. The discharge from these pumps is also connected by similar passages to pipes leading to the feed-water heater, or sometimes the columns supporting the heater serve as discharge pipes, and the water passes through them on its way to the heater. The heater usually consists of a wrought iron or steel shell riveted to cast iron heads, in which is a coil of copper pipe through which the exhaust steam from the main engine passes.

The water from the heater flows to the base plate and to the suction valves of the feed pumps, the head of water being sufficient to flood the valves and prevent the feed pump from missing stroke on account of vaporization of the heated water.

The lift pumps are fitted with long pistons, having cup leather packing in some cases and in others square gum packing fitted into suitable grooves is used, while the pumps are arranged with outside packed plungers having deep stuffing-boxes and heavy glands fitted to the pump barrels. The pump valves are flat discs of brass, properly guided and fitted to flat brass seats. The valves are made extra heavy so as to avoid the necessity of springs and at the same time allow ample metal for facing off. All the working parts are simple in construction and very accessible, so that the pump is able to work in all kinds of water, handling hot feed against high steam pressures, both effectively and economically.

The reason the "Doctor" is used in preference to other means of feeding is principally because engines of American Western river steamers are run non-condensing, and the feed is taken directly from the river, and in most cases contains a high percentage of sand and mud, which would quickly wear out injector tubes and cause an immense amount of trouble.

AMERICAN NAVAL APPROPRIATIONS.

The total sum appropriated by Congress for the American naval establishment for the fiscal year 1911 amounts to $131,350,854 (£27,000,000), which is $5,500,000 (£1,130,000) less than provided last year.

Among the various items included in the bill those authorizing the construction of new ships are of especial interest to the shipbuilders of the country. The bill provides for the construction of two first class battleships the cost of each not to exceed $6,000,000 (£1,233,000) to have a speed of 21 knots with a displacement or 27,000 tons (the cost is exclusive of armor and armament); the construction of six torpedo boat destroyers at a cost of $750,000 (£154,000) each; two fleet colliers of 14 knots speed to carry 12,500 tons when fully loaded, inclusive of bunker coal, the total cost of each not to exceed $1,000,000 (£205,500); the construction of four submarines at a cost of $500,000 (£102,800) each.

Besides the foregoing $445,000 (£91,500) is made available for the construction of a certain torpedo vessel of an experimental nature.

The suspension of the Bureau of Equipment was passed on by the present bill. The duties of said bureau shall, according to the bill, be distributed among the other bureaus of the Navy Department in such manner as the Secretary of the Navy considers expedient, and shall be in force until the end of the fiscal year 1911. The order containing the distribution of the duties assigns, besides the various assignments made to the Bureau of Navigation, Yards and Docks, Supplies and Accounts, to the Bureau of Construction and Repair the supply and manufacture of anchors, cables, rope, rigging, sails, awnings and flags, also the supply and fitting of galley appurtenances, the installation of electric wiring, voice tubes and devices of mechanical communication. To the Bureau of Steam Engineering is given electrical machinery and appliances, except those now in charge of other bureaus, the manufacture and installation of wireless telegraph outfits, both for ships and shore stations. Also the operation of coaling plants and the approval of the plans for such plants.

Of the appropriations provided for in the bill the following figures, given in round numbers, designate the purpose:

Pay of the navy	$34,615,500	(£7,125,000)
Bureau of Navigation	3,358,400	(691,000)
Bureau of Ordnance	11,363,500	(2,335,000)
Bureau of Equipment	8,038,300	(1,652,000)
Bureau of Yards and Docks	1,320,000	(271,500)
Public Works	7,090,000	(1,459,000)
Bureau of Medicine and Surgery	401,000	(82,500)
Bureau of Supplies and Accounts	8,065,000	(1,658,000)
Bureau of Construction and Repair	9,112,000	(1,870,000)
Bureau of Steam Engineering	6,276,000	(1,290,000)
Increase of the navy	33,775,000	(6,950,000)

The remainder is divided between the Naval Academy and the Marine Corps.

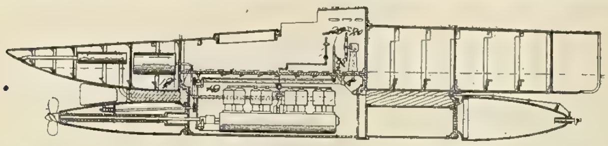
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

954,713. MARINE VESSEL. CLARENCE LIVINGSTON BURGER, OF NEW YORK, N. Y.

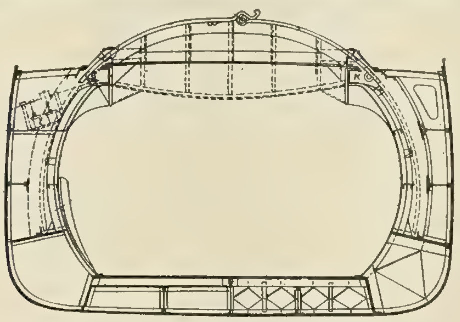
Claim 1.—A dirigible marine vessel consisting of a submerged hull suspended from and communicating with a surface hull, and having its



motor control accessible to the attendant in the surface hull, the submerged hull comprising an outwardly removable section to give access to the motor closely confined therein. Ten claims.

956,152. SHIP AND SHIP'S HATCH. JOSEPH R. OLDHAM, OF CLEVELAND, OHIO.

Claim 1.—In a bulk cargo vessel having a steel deck, the combination of transverse hatch coamings having channels or gutters on their peripheries, which rise on a curve from the decks at the sides of the hatchways; longitudinal slots in the deck near said sides, inwardly inclined longitudinal coamings at the sides of said slots, hatch chambers at the sides of the holds communicating with said slots, curved metal



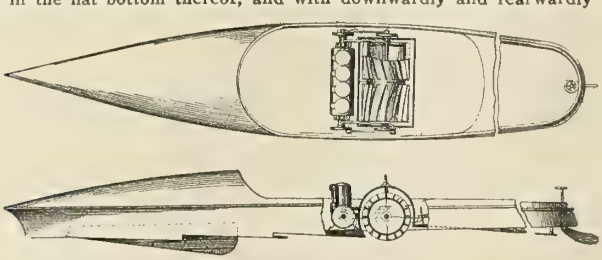
hatches adapted to slide or ride on rollers along said transverse coamings and through said slots into said hatch chambers, and portable hatch bars adapted to be fitted between said inclined coamings and the outside of the curved hatches to prevent water leaking into the hatch chambers, in which said hatches are housed when moved off the transverse coamings which support them. Nine claims.

956,442. WARSHIP. NABOR SOLIANI, OF SESTRI PONENTE, NEAR GENOA, ITALY.

Claim.—A battleship or cruiser provided with an armor belt and a protective deck having sloping sides which meet the ship's sides at a considerable distance below the lower edge of the armor belt. One claim.

956,487. HYDROPLANE BOAT. WILLIAM HENRY FAUBER, OF CHICAGO, ILL.

Claim 1.—A hydroplane boat having a pointed bow and a substantially flat bottom, and provided with a paddle wheel which is located at the widest part of the hull and projects downwardly through an opening in the flat bottom thereof, and with downwardly and rearwardly in-



clined hydroplane members extending transversely of said bottom forward and at the rear of the paddle wheel; said paddle wheel being substantially equal in length to the width of the hydroplane members at the front and rear of the same. Nineteen claims.

955,130. SHIP ELEVATOR, CRADLE, AND DOCK. EDWARD L. BURWELL, OF WINCHESTER, MASS.

Claim 2.—A counterbalanced elevator and cradle, the latter movable longitudinally on the former, means on the cradle laterally movable toward and from a vessel thereon, to maintain the vessel upright on the cradle, and means to govern the elevation and descent of the elevator and its load, said means including a system of weight units adapted to be brought singly into co-operation with the elevator, to act cumulatively thereupon. Twenty-five claims.

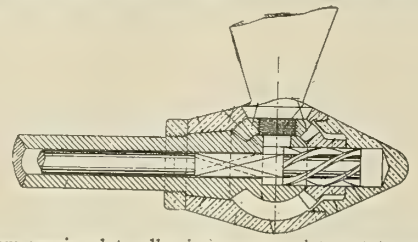
955,721. SCREW PROPELLER. RICHARD TJADER, OF NEW YORK, N. Y.

Claim 1.—A screw propeller having a continuous blade that extends a complete convolution about its shaft and that increases in pitch from front to rear in geometric progression. Thirty claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C.; and 21 Southampton building, W. C., London.

9,196. REVERSIBLE AND FEATHERING PROPELLERS. F. L. NEWHOUSE, H. M. S. *CAMPERDOWN.*

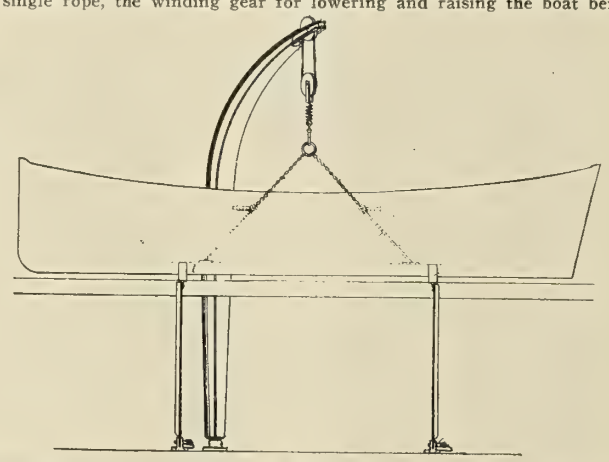
By this invention the blades are set at any desired angle by means of a push rod operated from within the ship or boat, through the hollow tail shaft. The push rod terminates in a coarse pitch screw, which carries a bevel wheel, and when the push rod is moved this bevel wheel,



prevented from moving laterally, is constrained to rotate and so in turn rotates the bevel wheels affixed to the base of the movable blades, thus giving the desired alteration in the angle of the blades and feathering, or reversing the pitch as may be desired.

16,610. BOAT'S DAVITS AND LOWERING GEAR THEREFOR. J. GRAHAM, GLASGOW.

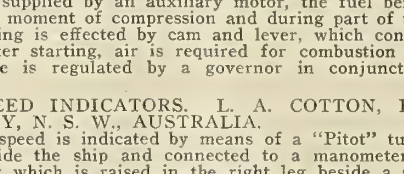
The invention consists in providing an improved single davit, which turns upon a vertical axis, and from which the boat is slung centrally by a single rope, the winding gear for lowering and raising the boat being



secured to and carried by the davit, and means are provided for automatically locking the davit in the outmost lowering position and also in the inboard position.

11,258. APPARATUS FOR EJECTING ASHES. F. J. TREWENT AND W. E. PROCTOR, LONDON.

Claim.—The ashes are charged into a hopper through a suitable valve. Water is forced into the annulus to issue from jets and force the mix-



ture of ashes and water out through a valve which may be below the sea level. Various modifications and variations are described.

12,228. PROPULSION OF VEHICLES OR SHIPS. GEBRUDER SULZER, WINTERTHUR, SWITZERLAND.

Claim.—Relates to a two-stroke internal combustion engine started by compressed air supplied by an auxiliary motor, the fuel being injected and fired at the moment of compression and during part of the working stroke. Reversing is effected by cam and lever, which control the air admission. After starting, air is required for combustion only. The auxiliary engine is regulated by a governor in conjunction with a piston.

16,241. SPEED INDICATORS. L. A. COTTON, HORNSBY, NEAR SYDNEY, N. S. W., AUSTRALIA.

Claim.—The speed is indicated by means of a "Pitot" tube and balance tube outside the ship and connected to a manometer tube containing mercury which is raised in the right leg beside a speed scale. Surging of the mercury is prevented by small bore plugs in the connecting pipes and "drag" in the balance tube is avoided by setting its mouth at an angle. The speed is recorded, on a clockwork-moved strip, by a pencil on a lever oscillated by a solenoid. This is actuated by current passing through a fine wire traversing the mercury column. When the latter rises the resistance decreases and the pencil also rises.

30,342. FOG-SIGNALLING APPARATUS. G. FINGERLING, HANOVER, GERMANY.

The object of this invention is to substitute olfactory signals for audible signals. Fine spray of odoriferous matter is distributed around the ship by jets at points. The liquid, an ammoniacal solution, for example, is forced by steam or otherwise through a pipe, induces sea water up the pipes and is ejected as a mixture through a nozzle.

International Marine Engineering

SEPTEMBER, 1910.

A NEW DEPARTURE IN AMERICAN SHIPBUILDING.

On Aug. 6 there was delivered to the owners the steel freight steamship *Ruth,* constructed on the Isherwood system, and built at the yards of the Newport News Shipbuilding & Dry Dock Company, at Newport News, Va., to the order of the A. H. Bull Steamship Company, of New York.

This is the second vessel built at the Newport News shipyard for that firm of ship owners, the steamship *Jean* having been completed just a year previous. The *Jean* has been engaged in carrying phosphate rock from Florida to Northern ports, with return cargoes of coal. The *Ruth* has entered the same trade. These two vessels are practically identical in size and general arrangement, but in order to utilize to best advantage the limited draft of water available at the Southern ports, it was decided to build the second vessel on the Isherwood system of longitudinal framing.

The Isherwood system of framing has been in use for several years in Great Britain, and the number of vessels being built on this system there and on the Continent is increasing rapidly, as its advantages become more generally known. The *Ruth* is the second vessel built in the United States on the Isherwood system, the *Millinocket,* owned by the same firm, having been completed in June. A large freighter, nearing completion, will introduce this system of construction on the Lakes.

The ordinary method of building vessels consists of fitting closely spaced transverse members to hold the shell and deck plating up to their work, and to prevent local deformation. As is well known, however, the principal stresses on vessels, due to their loading and to the action of waves, are longitudinal. The longitudinal members of a vessel, such as the shell plating and the deck plating, have to be of sufficient scantling to withstand these stresses. On the Isherwood system the shell and deck plating are stiffened by longitudinal framing, which adds to the material available for resisting the longitudinal stresses, and enables a reduction to be made in the thickness of the shell and deck plating without any sacrifice of strength. Transverse stiffness is provided by transverses, or web frames, spaced about 12 feet apart, forming continuous belts across the vessel. By this combination of framing the strength of the vessel is maintained at a considerable saving in weight.

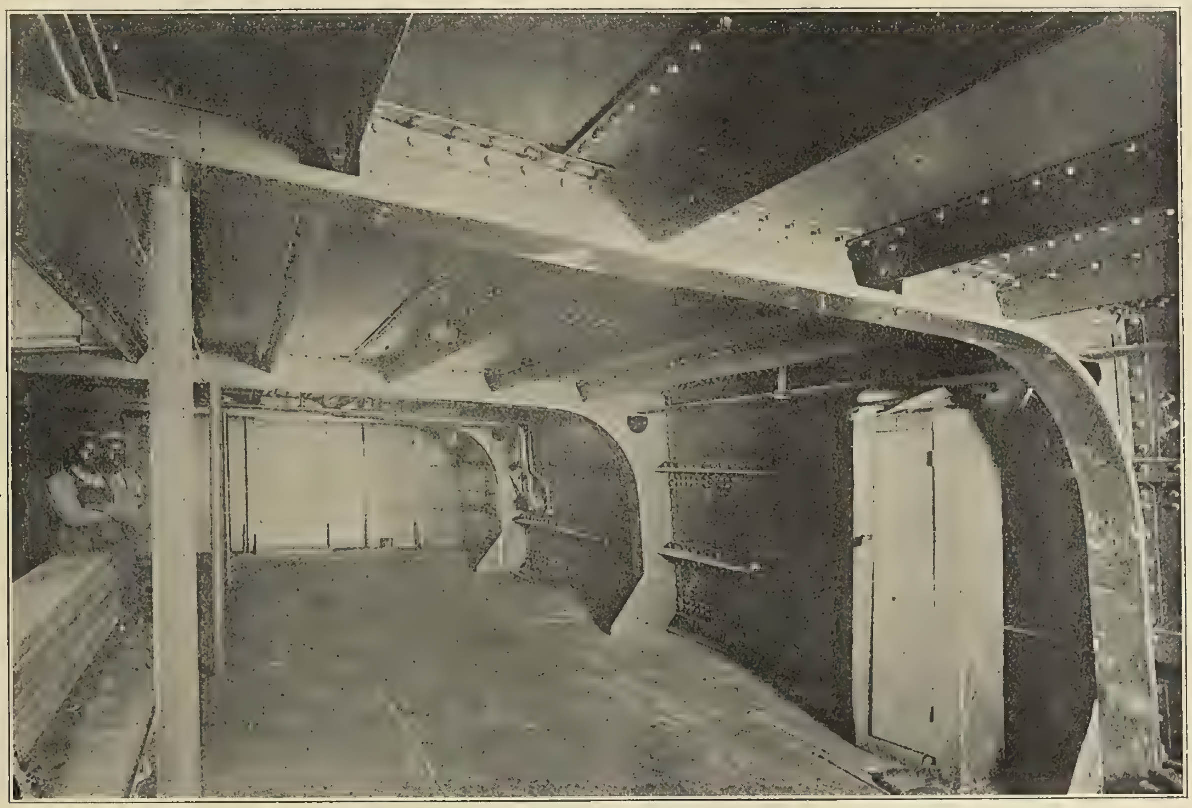


FIG. 1.—CONSTRUCTION OF BRIDGE ENCLOSURE ON THE LONGITUDINALLY FRAMED FREIGHT STEAMSHIP RUTH.

On account of adopting this method of framing the *Ruth* is able to carry at the same draft 120 gross tons of cargo more than the *Jean,* built on the transverse system and of the same dimensions. This is equivalent to a saving of 4 inches in draft. This larger carrying capacity materially increases the net earning capability of the vessel, and the first cost is not increased by the adoption of this system of framing, as the

weight of steel material worked into the hull is about 9 percent less on the *Ruth* than on the *Jean*. In certain classes of vessels the saving in weight is considerably greater than on the *Ruth*.

Although this is the first vessel built on the Isherwood system at the Newport News yard, the adaptability of the system to rapid construction is shown by the following building schedule:

Contract signed, Dec. 15, 1909. First material received in yard, Feb. 17, 1910. Keel laid, March 2, 1910. Framed, May 11, 1910. Plated, June 2, 1910. Launched, June 11, 1910. Engines installed, July 18, 1910. Dock trial, July 29, 1910. Completed and delivered, Aug. 6, 1910.

It will be noted that the vessel was on the stocks only three months and nine days, and was delivered in seven months and twenty-two days after the signing of the contract.

The general appearance of the vessel and the details of construction are shown by the illustrations. The following particulars may be of interest:

Length over all	328 feet.
Length from fore side of stem to after side of rudder post	318 feet 6 inches.
Beam, molded	46 feet.
Depth, molded	24 feet 3 inches.
Load draft	20 feet.
Deadweight capacity at load draft	4,740 tons.
Coal bunker capacity	784 tons.
Cargo capacity	248,000 cubic feet.

The vessel is fitted with one triple-expansion engine; cylinders, 22 inches, 37 inches and 60 inches diameter by 42 inches stroke; two Scotch boilers, 15 feet diameter by 10 feet 10 inches long, built for 180 pounds pressure, natural draft, and one donkey boiler, Scotch, 9 feet diameter by 10 feet 5½ inches long, built for 90 pounds pressure. There is a steam windlass, a steam capstan aft, an electric plant and five steam winches.

The vessel was built under special survey of British Lloyds to their highest class.

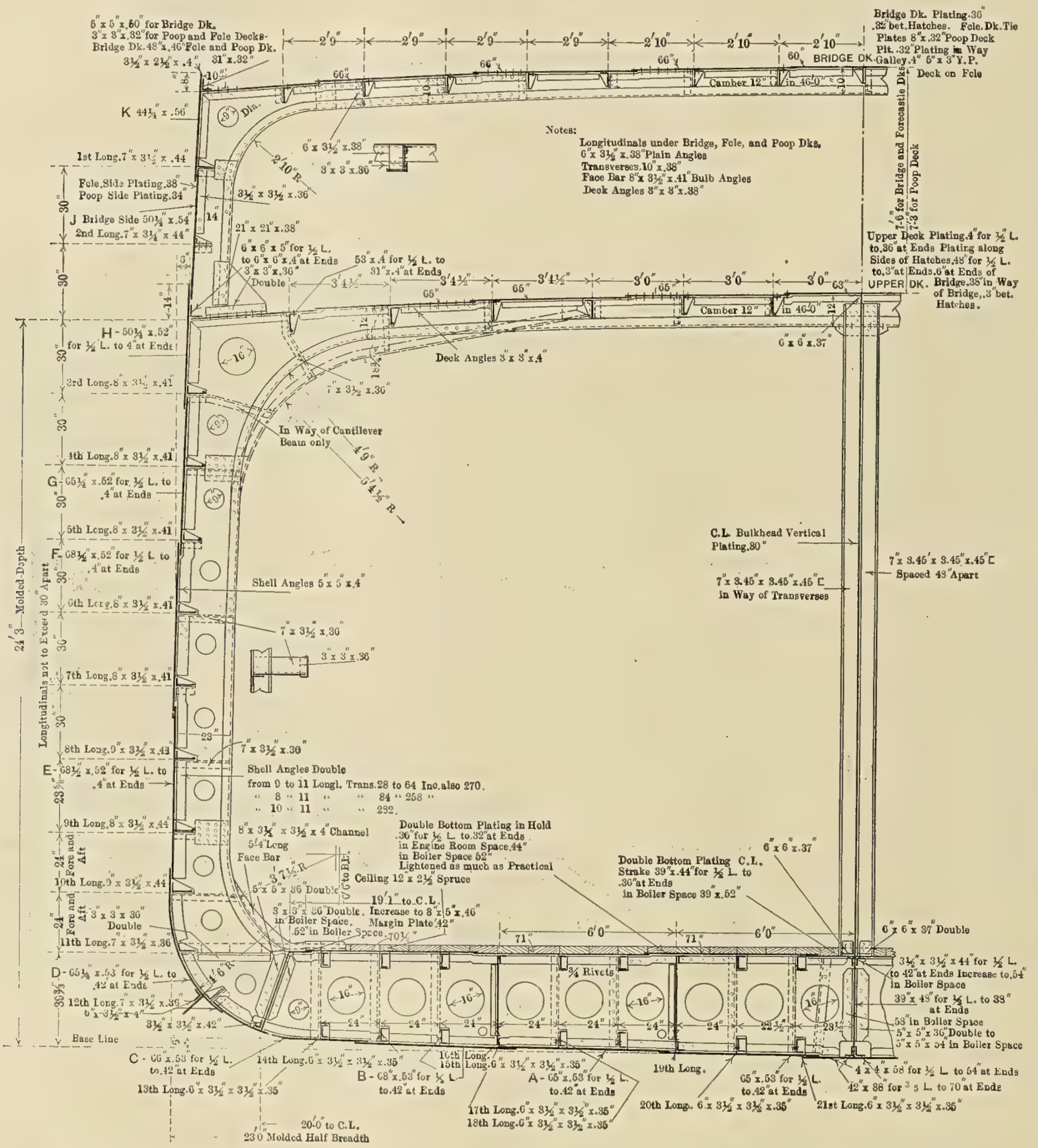


FIG. 2.—MIDSHIP SECTION OF THE NEW BULL FREIGHTER, BUILT ON THE ISHERWOOD SYSTEM OF LONGITUDINAL FRAMING.

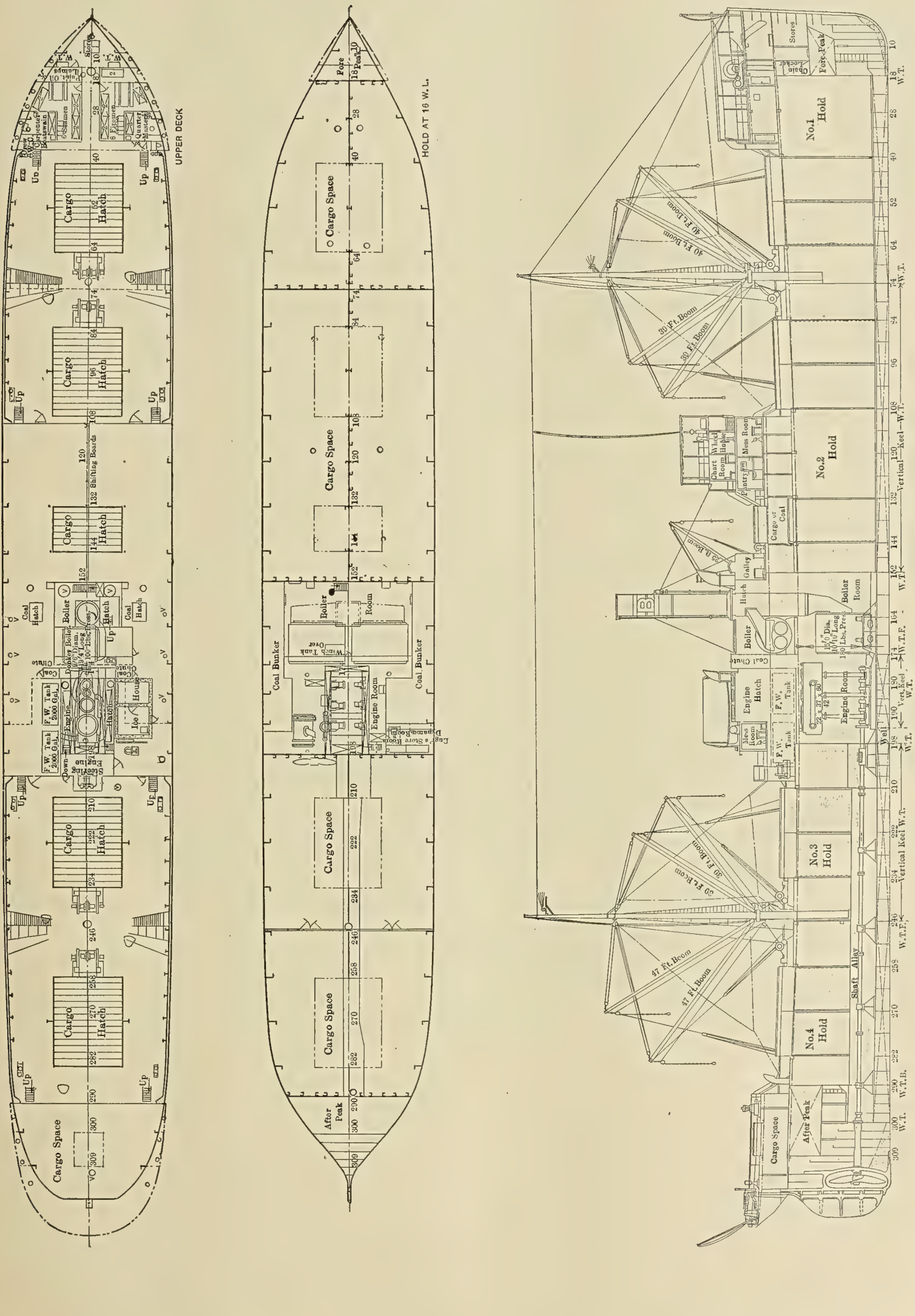


FIG. 3.—INBOARD PROFILE, HOLD AND UPPER DECK PLAN OF THE RUTH

THE BOAT PROBLEM.

BY SIDNEY F. WALKER.

In view of the very great importance, the literally vital importance, of boats to every class of seagoing ships, the fact is very striking that so little has been written upon the subject, either in the transactions of institutes or in technical journals. Though each successive great liner that has been launched has been described in very minute detail, it is difficult to find a sentence referring to the boats she carries, unless it happens to be in connection with some hoisting gear incidentally devoted to boats.

The boat problem divides itself into two—the boats required for men-of-war and those required by ships of the mercantile marine. And again the problem, so far as the mercantile marine is concerned, divides itself into two—the boats required by ships carrying passengers and those required by ordinary cargo ships. The boat question has followed, at some distance, the development which has taken place in the construction of ships themselves. Forty years ago the sailing ship still held the field, and ships were still largely built of wood. Iron was only then coming into use, and steel was practically tabooed. Now the sailing ship has almost ceased to exist, and the use of wood for the construction of seagoing ships of all classes has also almost ceased. At the present time the boat problem is passing through a transitory stage similar to that through which ships passed some thirty years ago. Steel is steadily making its way for boat construction, but it is still looked at with suspicion, just as iron was for ship building forty years ago. Steel-built boats have many advantages over wood building, but they still have some disadvantages. With the same propelling power they will not develop the same speed, and they will not stand the knocking about when lying alongside accommodation ladders or piers that the wood-built boat will without showing the marks. Hence, steel for boat construction is making its way slowly for men-of-war, and for a large section of the mercantile marine, on account of its greater cost, and the possibility, if care is not taken, of the boats being found badly damaged by rust, etc., when wanted.

FIG. 4.—STEAMSHIP RUTH, ONE OF THE FIRST LONGITUDINALLY FRAMED VESSELS BUILT IN AMERICA.

THE MAN-OF-WAR BOAT PROBLEM.

The man-of-war boat problem is quite different to the mercantile marine boat problem, because of the different conditions under which the two services are carried on. Both cargo and passenger steamers, on arrival at port, nearly always go right into dock or alongside a wharf to discharge, and take in cargo, and boats are therefore only required occasionally for officers' use and in case of disaster. Men-of-war lie always at a long distance from the shore, and the boats of the ship are required to take officers and crew to and from the shore, and from one ship to another in time of peace, and they are also required in war time to carry armed men and guns for attacking other ships or for landing. One requirement is common, however, to both the naval and mercantile marine in the matter of boats: every ship must carry a sufficient number with sufficient cubical capacity to accommodate all hands in case of wreck.

In the sixties and seventies, when wooden frigates were the largest naval vessels at sea, with an occasional two-decker and with a few of the ironclads as they were then called, wooden ships plated with iron, the boats carried by the largest men-of-war were as follows: Two launches, each pulling eighteen oars; one pinnace, pulling fourteen or sixteen oars; two cutters, pulling ten oars each; a smaller cutter, usually called the jolly boat, pulling eight oars; a galley, pulling six oars, single banked for the captain; a gig, pulling four oars, single banked for the commanding officer, and a dinghy pulling two oars. All of them carried crews corresponding to the number of oars, plus a coxswain and a midshipman or sub-lieutenant for each boat except the gig and dinghy. All of them also carried sails, the launches and pin-

nace being schooner rigged, the cutters, jolly boat, galley, gig and dinghy lug rigged. All of them were built of wood, the launches and pinnaces usually carvel, or with smooth skins, and the remainder clincher, the outside boards overlapping each other like the scales of a fish. When at sea the launches were stowed in crutches in the waist, between the fore and main mast, the pinnace and the smaller boats, except the two cutters, inside the launches. Two cutters were kept at the quarter davits, ready for lowering in case of a man overboard. In war time, when attacking other ships or shore defences, the launches and pinnaces carried small breech-loader guns, and in landing men for shore work one of the launches carried the field gun, which formed part of the equipment of large ships of those days. All of the crews carried rifles and side arms, and in addition the larger boats had a certain complement of marines.

At the present time the row boats carried are very much the same as in the old days, except that whale boats have been added and the larger boats are driven by steam. The steam launches, pinnaces and cutters do the greater part of the work of carrying officers and men and stores between the ship and the shore and from ship to ship. In steam-propelled boats there has been a continual development since about the year 1864, and it has been largely due to the work of Mr. J. Samuel White, of East Cowes, Isle of Wight. In the early sixties, Mr. White attacked the problem of the production of a lifeboat that was really unsinkable and the propulsion of the boat by steam, and he was so successful that the Admiralty adopted his ideas. At the present time steam pinnaces, as they are now called, 56 feet and 40 feet long, steam barges, 40 feet and 32 feet long, and steam cutters, 32, 27 and 23 feet long, are carried by the different classes of ships in the British navy. Battleships and cruisers carry two or three pinnaces of 40 feet or 56 feet length, according to the size of the ship, flagships carrying what is practically a steam pinnace for the use of the admiral called a barge. It takes the place of the twelve-oar barge of the sailing ship days. Smaller ships, second and third class cruisers, torpedo boat destroyers and surveying ships, carry steam cutters of different sizes, according to the size of the ship. The speed of the steam-driven boats has been gradually increased from 8.3 knots in 1867 to 19 knots, the speed of boats recently turned out for foreign governments, and the indicated horsepower of the engines carried by steam-service boats has increased from 31 to 300. Other developments have taken place, such as the substitution of watertube boilers for the locomotive type

FIG. 5.—PARTIAL VIEW OF THE AFTER HOLD OF THE S. S. RUTH, SHOWING LONGITUDINAL FRAMING.

employed in the early steamboats, the addition of condensers and forced draft, and a very large increase in the speed of the engine, from about 280 up to 550 revolutions per minute. The fuel capacity has been quadrupled.

The steam-driven boats of the British navy have so far only employed coal as a fuel, except in the case of boats permanently used in harbor service, in which oil fuel has been employed to a small extent. Attempts are being made, the writer understands, to adapt the heavy oil fuel that is now being carried in some of His Majesty's ships for boat service, but the use of gasoline (petrol) is looked upon with great suspicion, because of its inflammability. The writer understands, however, that in America gasoline (petrol) is finding greater favor. For men-of-war's boats internal-combustion engines of all kinds are at a serious disadvantage, as compared with steam engines, on account of the greater convenience of control of the steam engine. When a large fleet is at anchor, say at Spithead or at Hampton Roads, there is an enormous amount of traffic between the individual ships and the flagships, and the question of keeping the accommodation ladder clear, for the different officers as they arrive, is often a very troublesome one to the officer and midshipmen of the watch. Boats come alongside, discharge their officer, or whomever they may bring, and are obliged immediately to clear off to make way for another boat. Naval etiquette also demands that a junior officer, who may be coming alongside, and who sees a senior officer about to come, should get out of his way, if necessary not going alongside until his senior has gone on board. All this requires very complete command of the boat, the ability to go easily or quickly ahead or astern at very short notice, and so far, for this purpose, steam is the ideal power. In the old days, whenever there was wind enough, midshipmen of boats delighted in sailing, and it was splendid exercise, considerable skill being required to bring a boat nicely alongside the gangway when approaching under sail. It is probable, however, that in the near future oil fuel and the internal-combustion engine will come in for men-of-war's boats with the advances that are being made in the flexibility of oil engines.

BOATS FOR THE MERCANTILE MARINE.

The boats carried by the mercantile marine are governed entirely by the number on board. In the United Kingdom, the Board of Trade have an elaborate set of rules governing the minimum number of boats that each ship must carry and their cubical capacity, the rules being based upon the ability of the boats to save all hands in case of wreck. The boats carried must provide 10 cubic feet of boat capacity for each adult person on board the ship, or alternatively, they may carry a certain number of boats and a further capacity in life rafts and other appliances to make up the difference, the capacity in life rafts or other appliances being larger in proportion than is required in boats. Life rafts are required to have an air capacity of 3 cubic feet for every adult person. Thus with large liners of 10,000 tons and upwards gross, carrying passengers, the minimum number of boats is sixteen, and the cubical capacity 5,500 cubic feet, smaller ships carrying passengers have a smaller number in proportion. The American law requires a further addition for the large ships that have been recently introduced. A ship of 24,000 tons gross tonnage, say, carrying passengers, must have a certain number of additional boats, partly of the ordinary build and partly collapsible. Of the boat capacity required by the British Board of Trade, ships of 10,000 tons gross register carrying passengers would have fourteen lifeboats, each 30 feet long 9 feet wide and 4 feet deep, and two cutters 25 feet long 7 feet wide and 3 feet deep.

The lifeboats carried by passenger ships are of the whaleboat form, with bow and stern built alike and with air chambers formed, either in the boat itself or carried outside the boat, sufficient to give buoyancy such that, with the boat full of water, and with its full complement of crew and passengers it would be impossible to submerge it. They are also fitted with life lines running round the outside of the boat in loops, so that persons in the water may catch hold of them and be drawn into the boat. The lifeboat, it will be remembered, has been developed from the boat that has been carried by whaling ships almost as long as the whale has been hunted, and which has been found so handy in a heavy seaway.

Cargo steamers, of which the tramp class form the larger proportion, carry only a small number of boats, because they have only a comparatively small number of hands. Tramp steamers carry two lifeboats, one on each side of the ship, the two boats being of sufficient capacity to carry all hands and being kept ready to lower at short notice. The writer understands that usually one boat will carry the whole crew. Two smaller boats are also kept for use when the ship is in port, if she happens to be lying in the roads for a short time, to convey the captain or crew to and from the shore. These are the usual square-stern gig or dinghy type.

The lifeboats carried by the passenger ships and by cargo steamers are required by the British Board of Trade rules to be kept under davits; that is to say, ready for immediate use. As those who go down to the sea in ships know, sometimes to their cost, and as those who read the daily papers will have learned also, in cases of collision the time allowed for getting out of the ship is nearly always very short indeed. In cases also where the ship has to be abandoned, owing to damage in stormy weather, the facilities with which the boats can be got out and lowered under the severe conditions which then rule have a very important bearing indeed upon the question whether the lives of the crew can be saved or not, and whether they get one more chance of reaching home. Lowering a boat at sea, even under the most favorable conditions, is a difficult matter. The writer proposes to deal with the whole of this in a later article.

BOAT CONSTRUCTION.

In the old days all boats were constructed of wood, some being built on the carvel system and others on the clincher system. The carvel system, which was employed for the larger boats, such as launches and pinnaces, in the British navy, but which was also employed to a certain extent in boats built for the mercantile marine, and is even up to the present day, may be described as diagonal planking. It presented a smooth surface to the water on the outside, but for smaller boats was not considered so strong as clincher construction. The large steam-driven boats of modern men-of-war used in the British navy are carvel built, with two and sometimes three skins, each consisting of diagonal planking, the direction of the planks being arranged to cross each other, and the two, or the three skins, being separated by layers of waterproof canvas, etc.

In clincher-built construction the boats were formed of a number of planks, running fore and aft, and lying over each other like the slates on the roof of a house. All wooden-built boats are formed on a frame of ribs, keel, stem and stern post, the timbers forming the skin of the boat being secured to the framework by copper bolts and by inner members, known as the keelson, false stern post and stemson. The construction is, in fact, on very much the same lines as that of a ship. With steel boats, however, a different system of construction has been introduced which does not depend so much on the framework.

STEEL BOATS.

The steel boats which are being built for the mercantile marine are made on something the same lines that the large

coal wagons are constructed. Each boat is stamped out from sheet steel in two halves, just as the sides and other frame members of railway wagons are, by hydraulic pressure. The two halves are bolted together along the line of the keel, stem and stern post, and are then fitted with wooden thwarts, bottom boards, stern sheets, etc. The steel boats of this type are made in practically all sizes by the Seamless Boat Company, of Wakefield. Some steel boats have also been built by Messrs. J. Samuel White & Company for foreign governments, the steel employed being galvanized hot.

COLLAPSIBLE BOATS.

In addition to wood and steel a class of boats has been developed for use in the mercantile marine designed to occupy smaller space on board ship than either wood or steel, and therefore to enable a larger proportion of boat capacity to be carried in a smaller space. Of these, one of the best known is the Berthon, which may be described as built up of a number of canvas members. Each canvas member consists of a framework of wood, forming part of the frame of the contour of the boat when in place, and having two sheets of specially prepared canvas stretched over them. When the boat is not in use the frames, with their canvas covers, fold up together very much as the leaves of a book fold, the keel taking the place of the back of the book and the leaves the canvas-covered frames, being attached to the keel, the stem and stern post. The thwarts, bottom boards and other inside fittings, which are of wood, are made in halves and hinged in the center, so that they also fold up inside the boat when the latter is stowed. The thwarts are supported by stanchions in the usual way, and are fitted with hooks for lowering and the other appliances necessary for ordinary boat work. When stowed they lie flat against the ship's side, or wherever it may be convenient to stow them, with their oars and other appurtenances carried between the sides of the boat. For ship work the boats are usually made on the whale or double-bowed system, and they are constructed of sizes ranging from 7 feet in length up to 28 feet. The canvas employed in their construction is especially strong, it having a breaking strain, cut longitudinally, of 570 pounds per inch of width, and when cut transversely of 370 pounds. It is claimed that the two canvas skins employed in the frames act as the air vessels in the ordinary lifeboat, rendering the boats unsubmergible. It is also claimed that the two skins give an immunity from damage such as could not be obtained with one skin. The boats are fitted with sails and oars just as ordinary boats, and one of them is stated to have sailed from Southampton to Liverpool. The Berthon boats are carried by several of the large ocean liners, but do not appear so far to have been adopted by the tramp class of steamer.

Another collapsible boat, built upon different lines, is the Engelhardt, made by the Lane & De Groot Company, New York, which is also claimed to be unsinkable and to have the advantage of occupying very much smaller space than the ordinary boat, while being ready for instant use. The Engelhardt boat is built to close up vertically, something on the lines of a concertina. The boats are built in various sizes, from 12 feet long by 5 feet wide up to 28 feet long by 9 feet wide. The 12-foot boat has a depth of 1 foot 9 inches when in use, and 1 foot when collapsed for stowage. The larger boats having a depth when extended for use of 2 feet 8 inches and when collapsed for stowage of 1 foot 6 inches. When at sea the Engelhardt boats are stowed in a nest one above the other, and can be triced out and lowered into the sea by suitable tackle, one after the other, as may be required.

The Institution of Electrical Engineers has moved to Victoria Embankment, London, W. C.

ON THE POWERING OF SHIPS.

BY SIDNEY GRAVES KOON, M. M. E.

When it becomes necessary to determine, for any new ship, the power required to drive her at a predetermined speed, several methods are in use, of which the most common is that employing what is known as the Admiralty formula:

$$H = \frac{D^{2/3} V^3}{K},$$

where H is the horsepower for speed V, expressed in knots; D is the trial displacement in tons, and K is a coefficient, called the Admiralty coefficient, or, sometimes, the Admiralty constant.

But K is not a constant. It varies with varying forms of ships, becoming larger as the form becomes finer and better fitted for maintaining the desired speed. It varies with the size of the ship, becoming very slowly larger as the size increases. It varies with the speed of the ship, becoming smaller as extreme speeds are reached, and larger when a more moderate performance is approached.

It is in the assumption of this coefficient K that the genius and experience of the naval architect are brought into play in connection with the designing and powering of a new ship. He has before him a mass of data on the performances of previous ships, from which the coefficient has been deduced by a reversal of the formula into

$$K = \frac{D^{2/3} V^3}{H}.$$

He has in mind the form and general proportions of the new ship. He goes over his data until he finds a case which approximates, more or less closely, to the one in hand. And then the value is chosen and the required power computed.

In this latter operation he usually allows a slight margin for the unexpected, and as a result is disappointed, if on the trial trip the ship does not do a little better than demanded by the contract. But it may here be stated, as a general proposition, that a unit which develops 10 percent more power than that for which it was designed, gives just as poor a result, from the standpoint of mere design, as does that which falls short in the same ratio. From the broader commercial viewpoint of fulfilling the conditions of the contract and providing a definite result, however, any excess is usually welcomed, unless purchased at the expense of something else, such as economy or margin of safety.

For the purpose of illustrating some of the problems involved, and of affording opportunity for elaborating upon them, a list of some twenty types of battleships (Table I) and as many of armored cruisers (Table II.) has been prepared,* which gives the main particulars of the design, so far as powering is concerned, and similar data for the actual trial performances. In the *latter*, in order to eliminate irregularities due to stress of weather or other disturbing elements, the results are shown as the *averages* of a number of ships of the same types, the number so included being indicated, and being, with a few exceptions, the total number of that type built. In this manner it has been possible to give results covering more than 150 prominent vessels in the compass of a list tabulating 41. The ships are selected from the lists of the seven leading navies.

A cursory examination of the tables shows that, with the sole exception of the Italian *Regina Elena* (three ships), among the battleships, and of the French *Jeanne d'Arc* among the armored cruisers, all of the vessels listed have exceeded the required speed; the maximum excess being 1.29 knots in

* It is usually difficult to obtain sufficiently comprehensive data from the trials of merchant ships.

TABLE I.

Ship.	Design.					No.	Result.				
	Tons.	*b. c.*	Horse-power.	Speed.	*K.*		Horse-power.	Speed.	*K.*	Excess Power.	$\sqrt{\frac{V}{L}}$
Jupiter	14,900	.634	12,000	17.5	270	8	12,300	18.26	294	2.5%	.914
Ocean	12,950	.602	13,500	18.25	248	6	13,835	18.41	249	2.5	.92
London	15,000	.637	15,000	18.	236	8	15,405	18.26	240	2.7	.901
Triumph	11,800	.516	12,500	19.	284	2	13,750	20.11	307	10.	.94
Duncan	14,000	.586	18,000	19.	221	6	18,271	19.07	221	1.5	.933
Dominion	16,350	.625	18,000	18.5	227	8	18,444	18.83	233	2.5	.899
Agamemnon	16,500	.633	16,750	18.	226	2	17,365	18.82	249	3.7	.913
Dreadnought	17,900	.555	23,000	21.	*275	1	24,712	21.25	†266	7.4	.932
Nebraska	14,948	.659	19,000	19.	219	5	22,148	19.1	192	16.6	.916
Idaho	13,000	.643	10,000	17.	272	2	13,563	17.13	206	35.6	.885
Kansas	16,000	.667	16,500	18.	224	6	18,895	18.51	214	14.5	.873
Michigan	16,000	.633	16,500	18.5	244	2	17,334	18.83	246	5.	.888
Delaware	20,000	.597	25,000	21.	*a*273	2	*b*32,130	21.6	234	28.2	.956
Gaulois	11,260	.601	14,500	18.	202	2	15,108	18.08	196	4.1	.926
Patrie	14,635	.54	17,475	18.	200	6	19,370	19.29	222	10.9	.921
Wettin	11,643	.596	15,000	18.	200	2	14,928	18.12	205	.....	.906
Elsass	13,000	.59	16,000	18.	202	9	17,685	18.58	200	10.5	.918
Margherita	13,214	.514	19,000	20.	235	2	20,532	20.3	228	8.1	.982
Flena	12,425	.5	20,000	22.	286	3	21,150	21.89	268	5.8	1.015
Mikasa	15,200	.619	15,000	18.	238	4	16,500	18.68	242	10.	.917
Kashima	16,400	.605	17,000	18.5	240	1	17,280	19.24	266	1.5	.901

* Equivalent for I. H. P.—242. † Equivalent for I. H. P.—234. *a* Equivalent for I. H. P.—240. *b* Equivalent for I. H. P.

TABLE II.

Ship.	Design.					No.	Result.				
	Tons.	*b. c.*	Horse-power.	Speed.	*K.*		Horse-power.	Speed.	*K.*	Excess Power.	$\sqrt{\frac{V}{L}}$
Cressy	12,000	.507	21,000	21.	231	6	21,358	21.61	248	1.7	1.014
Drake	14,100	.519	30,000	23.	237	4	31,094	23.2	235	3.6	1.022
Berwick	9,800	.482	22,000	23.	253	10	22,494	23.27	257	2.2	1.109
Argyll	10,850	.503	21,000	22.25	257	6	21,531	23.13	282	2.5	1.09
Natal	13,660	.502	23,500	22.33	271	6	23,757	23.17	299	1.1	1.058
Shannon	14,600	.511	27,000	23.	269	1	28,553	22.6	241	5.8	.992
Minotaur	14,600	.499	27,000	23.	269	1	27,856	23.01	261	3.2	1.01
Milwaukee	9,700	.516	21,000	22.	231	3	25,841	22.13	191	23.1	1.075
Colorado	13,680	.572	23,000	22.	265	6	27,427	22.28	232	19.2	.994
Tennessee	14,500	.557	25,000	22.	253	4	27,781	22.29	238	11.1	.995
Jeanne d'Arc	11,092	.482	28,500	23.	212	1	28,900	21.7	176	1.4	.995
Montcalm	9,367	.464	19,600	21.	210	2	20,021	21.14	210	2.2	.993
Gloire	9,856	.486	20,500	21.	208	4	21,888	21.61	212	6.8	1.015
Gambetta	12,351	.493	27,500	23.	236	4	28,457	23.01	229	3.5	1.055
Renan	13,347	.481	37,000	23.	185	1	37,780	24.2	211	2.1	1.066
Yorck	9,348	.516	19,000	21.	216	2	20,460	21.29	209	7.7	1.061
Scharnhorst	11,319	.509	26,000	22.5	221	1	27,759	22.71	213	6.8	1.079
Nisshin	7,700	.507	14,000	20.	223	2	14,916	20.15	214	6.5	1.066
Asama	9,750	.515	18,000	21.5	252	2	19,417	22.58	271	7.9	1.118
Iwate	9,750	.514	14,500	20.75	281	2	15,909	21.89	301	9.7	1.095
Bayan	7,726	.498	16,500	21.	219	2	18,508	22.28	234	12.2	1.058

the French *Patrie* (six ships), 1.28 knots in the Russian *Bayan* (two ships), and 1.2 knots in the French *Renan;* all of these ships having been built in France.

Closer examination reveals the fact that the British ships, almost without exception, have given on trial better results, as measured by the Admiralty coefficient, than the design called for. The American ships, on the other hand, with the single exception of the *Michigan* (two ships), have fallen far short of propulsive expectations, though all have attained the required speed. It will be further noted that all of the American ships (again with the exception of the *Michigan*) have exceeded their designed power by more than 11 percent; while none of the other vessels, with the exception of the *Bayan,* has exceeded by so much as 11 percent; in more than one-half the cases the margin is less than 4 percent. Either the American designers have allowed unusually liberal margins for excess power, amounting to over 23 percent in the cases of seven of the vessels listed, or these vessels have been hard pushed to develop the required speed, and as a direct consequence the last atom of power, if so we may express it, has been extracted in the attaining of this speed. However this may be, an examination of some of the elements leading to the attainment of the trial results may prove profitable.

Generally speaking, there are three elements which, taken together, determine the speed to be attained by any ship. The first and foremost is, most naturally, the power of her engines. A second and very powerful influence lies in the proportioning of the propellers and their location relative to the hull, and to the steam lines when the ship is in motion. Last, but not least, we have the form of the ship herself, both as regards the block and prismatic coefficients and as regards the wave contour thrown up by the hull when in motion.

Taking up, first, the subject of power, we may note that in every average case cited, with the exception of the German *Wettin* (five ships), the engines have developed on trial somewhat more than the designed power. This, together with the fact that the designed speed has generally been exceeded, disposes at once of the question of the adequacy of this element. In this connection, however, we may here remark that the newer ships, fitted with turbines, have a great advantage in this respect; for, as is well known, the turbine will respond nobly to excessive forcing, and that with very slight loss of efficiency as compared with full power. The piston engine, on the other hand, usually calls for an excessive amount of steam from the boilers once the limit of fairly easy working is passed. This means that, with equal boiler power and with equal engine power under "easy" conditions, the turbine would more effectively utilize the ultimate forcing of the boilers, and would, on the same steam consumption, impart a greater propulsive effect through the shafts. On the other hand, it is usually easier to fit propellers of high efficiency to reciprocating engines, because of the fact that screw propellers operate most effectively at relatively low speeds of revolution—speeds lower than are usual in turbine installations.

Regarding the subject of propellers, reams have been written and more reams are to come. We shall confine ourselves here,

however, to discussing a few phases of the question, mainly as illustrating the cases listed.

The four cruisers of the *Drake* class (British, 14,100 tons displacement) have been subjected to exhaustive experiments to determine the proper form and pitch of propellers to obtain the best propulsive results with this particular hull. Some of the data so acquired are embodied in Table III., and are shown in three sets of curves, one of which relates the Admiralty coefficient to the indicated horsepower; a second shows Admiralty coefficient plotted on speed, while the third depicts the relation between speed and apparent slip of the propellers.

TABLE III.

Ship.	Pitch.	I. H. P.	Speed.	*K.*	R. P. M.	Slip.
King Alfred..	23 ft. 9 ins..	6,743	15.17	302	72.3	10.5%
		21,450	21.6	274	104.9	12.2
		22,540	21.98	275	106.7	12.1
		31,156	23.46	242	120.2	16.7
Leviathan....	23 ft. 9½ ins.	6,481	15.24	319	71.2	8.9
		22,900	21.96	270	107.6	13.1
		31,592	23.25	232	122.1	18.9
Good Hope...	22 ft. 9½ ins.	2,689	10.6	259	51.	7.6
		5,096	13.63	290	65.8	7.9
		6,054	14.5	294	71.1	9.3
		7,953	15.91	296	77.5	8.7
		12,108	18.1	286	90.	10.6
		16,960	20.58	300	99.8	8.3
		22,478	22.09	280	109.1	10.
		22,703	22.09	277	109.9	10.6
		31,071	23.05	230	125.	18.
Drake.......	24 ft. 6 ins..	6,937	15.43	309	72.3	11.7
		23,103	22.08	272	105.9	13.8
		30,557	23.05	234	116.	17.8
	23 ft. 0 ins..	31,409	24.11	260	122.4	13.2

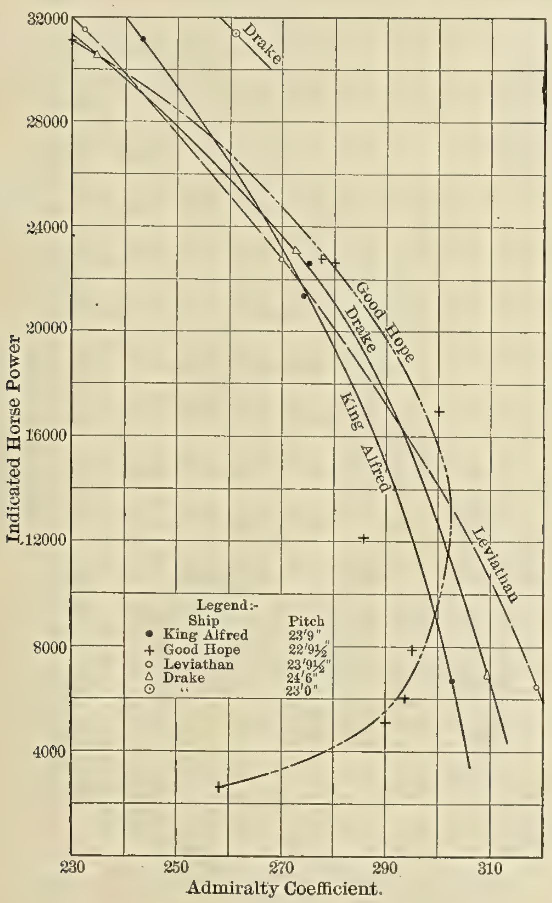


FIG. 1.

In each case we find an insufficient number of points to properly outline a curve upon which reliance can be placed, but the curves drawn may be considered fairly representative of the conditions obtaining. The one decidedly discordant point shown for the *Drake* was the result of fitting propellers of lower pitch and much increased blade area. The other cruisers have since been fitted with similar wide-bladed propellers, and have achieved equally good results. The third set of curves shows discordant points for the *Good Hope.*

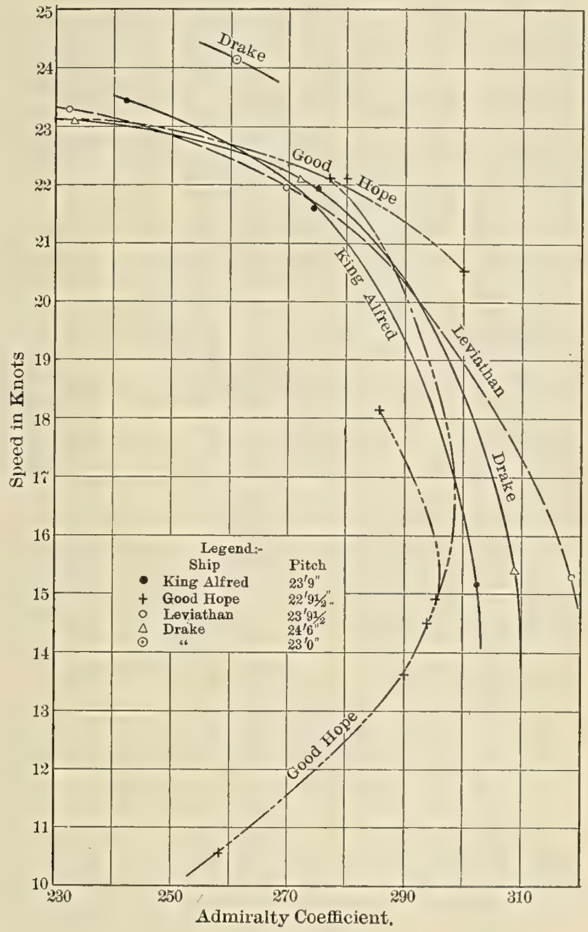


FIG 2.

A somewhat different result was obtained with the (three) propellers of the *Scharnhorst,* where an increase in pitch from 21 feet 3 inches to 24 feet 3 inches secured an improvement in the result, as follows:

Pitch.	I. H. P.	Speed.	K.	R. P. M.	Slip.
21 feet 3 inches....	27,759	22.71	212.7	120.2	9.9%
21 feet 3 inches....	18,052	20.69	247.3	107.3	8.0
24 feet 3 inches....	25,227	22.64	231.9	107.1	11.7
24 feet 3 inches....	16,695	20.45	258.2	95.1	10.2

Under full power, and also on the twenty-four-hour trial, the slip ratio has been increased by the change; but as the speed has been attained on a lower power, and with, presumably, a decreased fuel consumption, the result cannot but be regarded as satisfactory. For a short distance the *Scharnhorst* has made 24.1 knots.

Nearly all new power installations on warships provide for propulsion by steam turbines. This has made it necessary, in most cases, on account of the high speed of revolution, to resort to the use of relatively small propellers on three or four shafts. As the number has increased there has been an added amount of interference in the steam lines—the "wing" propellers, well forward, working in comparatively "solid" water, while the inboard, or after propellers, are compelled to operate in water already more or less disturbed by the action of the

forward set. This results in a heavy loss of efficiency, and it is now proposed to so design turbines as to utilize the entire power on two shafts, thus doing away with this disadvantage. This is already being done in Curtis installations, and it is expected that, at least for full-bodied models, the Parsons type will shortly fall in line. With fine-ended vessels this interference becomes less marked, for it is possible to place the wing propellers so far forward as to diminish, to a large extent, the swirl of water in which the inner propellers work; but for battleships the problem is decidedly important.

What effect the Melville spiral speed-reducing gear is destined to have on this question it is difficult to predict. It would appear that the saving in weight and space effected by

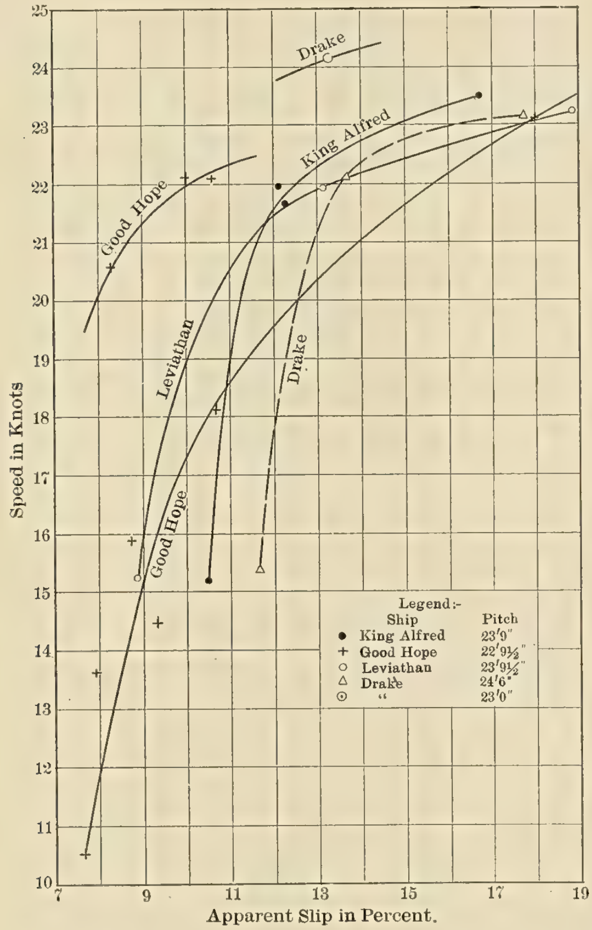


FIG. 3.

the use of faster-running turbines would be largely offset by the gears themselves; while the friction loss in the gears must needs be very small indeed to avoid neutralizing the gain in efficiency from the use of slower-running propellers. Propellers and shafting would be heavier than at present.

Our fourth diagram represents the relationship between block coefficient and Admiralty coefficient for the vessels listed. As might have been anticipated the points are "all over the lot." As a general proposition, however, it may be said that the higher the block coefficient the lower the Admiralty coefficient, and vice versa. In a few cases it has been possible to draw fairly representative curves, such as those for British armored cruisers, Elswick ships, French armored cruisers (the *Bayan* was built in France), and a line through the field of American battleships. One interesting feature is the fact that all of the vessels above and to the right of the line *A B C* (the richest part of the diagram, so far as performance is concerned) are Anglo-Saxon in both design and construction. It

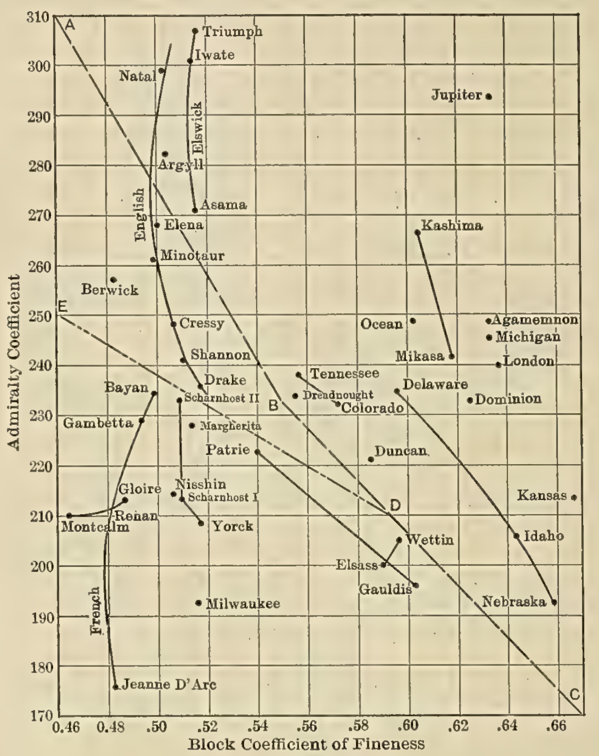


FIG. 4.

will be further noted that, aside from the *Regina Elena* (Italian, four ships), all of the vessels above and to the right of *E D C* are Anglo-Saxon; while the ineffective American *Milwaukee* (three ships) provides the sole Anglo-Saxon spot below this line.

So many other features enter into the problem that it is practically impossible to satisfactorily relate the two elements forming the ordinates and abscissæ of this diagram. Among

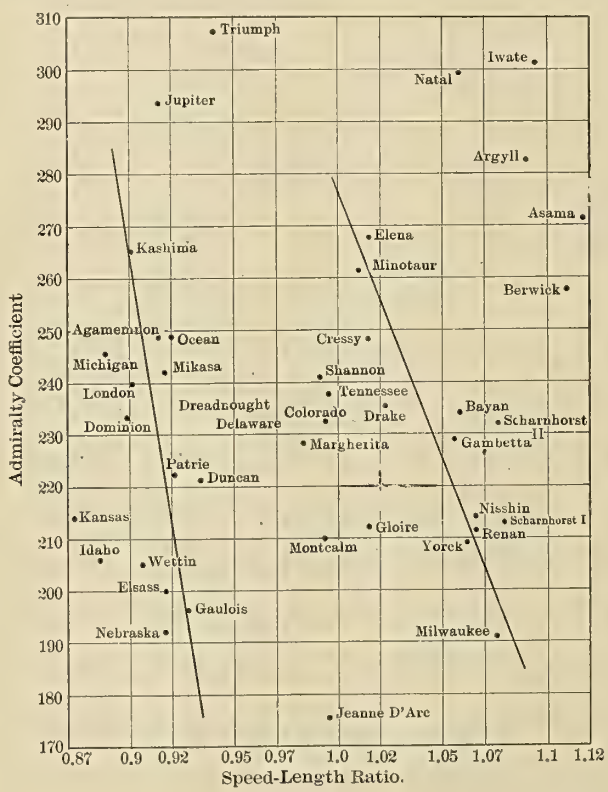


FIG. 5.

the important items affecting the result may be mentioned the relation of speed to square root of length. As this ratio increases above unity the problem of propulsion becomes harder to solve economically, and when it is above 1.2 it is usually undesirable to make the sacrifices in other directions which the speed demands.

A fifth and final diagram shows the relation between Admiralty coefficient and this speed-length ratio. It is found possible to draw a straight line, which represents, in some measure, the relation between these two elements for battleships and another for armored cruisers. It will be noted that in both cases the general trend is towards a higher Admiralty coefficient as the speed-length ratio decreases; also that the speed-length ratio attainable with the finer-formed cruisers is much greater for given propulsive efficiency than with the heavier battleships. The *Regina Elena* seems to be more closely allied with the cruisers than with the battleships; the same is true, in smaller measure, of the British *Triumph* (two ships). In both cases the lines are very fine, the block coefficient lying in the region usually assigned to fast cruisers. A collection of English-built cruisers in the upper right corner shows the best results of all. These are all vessels of fine form, and, apparently, with hulls exceptionally well designed and proportioned.

Attention may be directed to the American *Milwaukee* class (three ships) and the British *Berwick* class (ten ships):

	Tons.	I. H. P.	Speed.	K.
Milwaukee	9,700	25,841	22.13	191
Berwick	9,800	22,494	23.27	257

These two classes are of about the same dimensions and displacement, but the British vessels have the finer lines. They have the same batteries, and were designed for nearly the same horsepower. But the British vessel was expected to attain an extra knot of speed—and did so, though handicapped by having 13 percent less power. Could the American vessels have attained an Admiralty coefficient as high as that of the *Berwick* class (257), the mean trial speed on full power, with the engine power actually developed, would have been increased from 22.13 to 24.43 knots—a gain of 2.3 knots, or 10.4 percent. To attain this speed with the *Milwaukee's* Admiralty coefficient would require the development of 34,754 horsepower, or 8,913 more than the power attained on trial, and 13,754, or 65.5 percent, more than the design called for. A still more startling result may be shown by comparison with the Elswick-built Japanese cruisers *Asama* (two ships) and *Iwate* (two ships).

The table shows results for the *Shannon* and the *Minotaur*. These two ships, with a third, the *Defense*, were built at a time when discussion was rife on the relative merits of straight vs. hollow waterlines. In order to test out this matter the *Shannon* was built with hollow lines and the other two with straight lines. All three vessels are 519 feet long on the waterline and displace 14,600 tons; but while the *Shannon* is 75½ feet wide and draws 25½ feet of water (mean), the others are 74½ feet wide and draw 26½ feet. The *Minotaur* has a somewhat finer form than the *Shannon*. On trial the hollow-lined ship developed 700 more horsepower than her rival, but fell short 0.41 knot in speed. With the same horsepower for both vessels the loss of speed in the hollow-lined ship would have been 0.59 knot.

Most of the latest ships have benefited from the performance of tank experiments upon models. These experiments have frequently been the means of determining the forms of important ships, and are becoming more and more useful as our knowledge of their applications and limitations increases. A particularly good example of the beneficial results attending this manner of testing a drawing-room design lies in a comparison of the results given for the *Kansas* (six ships) and for the *Michigan* (two ships). Both types are of the same length, draft and displacement, and were designed for the same engine power. But the later *Michigan* was given 4 feet extra beam (80 feet, molded, in place of 76), and the lines so fined as to bring the displacement to the same figure as with her predecessors. Tank experiments showed that ½ knot better speed could be anticipated on the same power. The result showed 0.32 knot better speed with 1,561 horsepower less. Had the *Michigan's* engines developed the power actually attained by the *Kansas* class, her speed would have been (with her own Admiralty coefficient) 19.38 knots, or 0.87 knot better than the older type. This shows the value both of fine lines and of tank experiments for determining which, of several sets of proposed lines, will be most likely to give best results.

An example showing the relative suitability of certain ranges of speed for a given vessel is obtained by considering the trial results of the *Idaho* and *Mississippi*, as follows:

	I. H. P.	Speed.	K.	
Idaho	13,765	17.14	203.2	Full power trial.
Mississippi	13,361	17.11	208.6	
Mean	13,563	17.125	205.9	
Idaho	7,476	15.14	257.8	24-hour trial.
Mississippi	7,215	15.13	267.1	
Mean	7,345	15.135	262.5	

These ships are short and "stubby"—375 feet waterline by 77 feet beam; and though the block coefficient is but 0.643, they are obviously much better fitted for the more moderate speed. This lower speed, obtained on twenty-four-hour trial, would have required, at the Admiralty coefficient of the four-hour full-power trial, no less than 9,364 horsepower, or 2,019 (27.5 percent) more than was actually developed for the lower speed.

The trials of the *Delaware* and *North Dakota* afford a final example for comparison. These are twin-screw sister ships of 20,000 tons displacement, fitted, respectively, with reciprocating engines of 25,000 indicated horsepower (designed), and Curtis turbines of 25,000 shaft-horsepower (designed). The trials at full power produced:

	I. H. P.	S. H. P.	*V*.	*K*.	*K'*.
Delaware	28,578	......	21.563	258.5	......
North Dakota	......	31,400	21.64	......	237.8

Assuming the usual 88 percent engine efficiency, the *North Dakota's* equivalent in indicated horsepower would be 35,682, and her Admiralty coefficient 209.3, a considerable reduction, and a very decided drop from that given by the performance of her sister ship. This example illustrates the great adaptability of the steam turbine for overloading, as mentioned above.

This is merely a desultory study of a few of the more important points entering into the powering of large ships. It attacks a few of the problems involved, and shows something of the underlying causes affecting the results. It is analytic and critical, rather than constructive, for no attempt is made to furnish a panacea for propulsive weaknesses. It may, however, offer some pertinent suggestions to the thoughtful mind.

Errata.—In the August instalment of the serial article on "The Marine Steam Engine Indicator," the following errors occur: On page 318, near the top of the second column, the sentence beginning "The drum end should be examined, etc., should read, "The drum cord should be examined for chafe, etc.," and further on, in the same paragraph, the sentence, "If fouling is indicated remove the piston at once, wipe it off with cloth—not water—etc.," should read, "If fouling is indicated, remove the piston at once, wipe it off with cloth—not waste—etc."

A NEW LAKE PASSENGER STEAMER.

The latest addition to the fine fleet of passenger steamers of the Great Lakes of North America is the new steel steamer *Alabama,* just delivered to the Goodrich Transit Company of Chicago, Ill., by the Manitowoc Dry Dock Company, Manitowoc, Wis. This steamer is probably the most complete and elaborate craft of her size and kind on fresh water, and no expense has been spared to proide for the safety and comfort of the passengers. The subdivision of the hull by an unusually large number of watertight bulkheads makes the ship practically unsinkable, and a complete automatic sprinkler system as well as special fire pumps affords absolute fire protection. All conveniences known to modern ships, such as wireless telegraph outfits, refrigerating plant, running water in staterooms, drinking water systems, etc., have been installed.

The principal dimensions of the ship are as follows:

Keel length	250 feet
Length over all	271 feet 6 inches
Beam, molded	44 feet
Depth to main deck	17 feet
Depth to spar deck	27 feet
Draft aft	12 feet 6 inches
Draft forward	9 feet
Gross tonnage	2,626 tons
Net tonnage	1,684 tons

There are five decks, *viz.*: Orlop, main, spar, promenade and boat decks. The hull is constructed of mild steel, and divided into eight compartments by watertight bulkheads, and the orlop deck is watertight in Nos. 1, 2, 3 and 7 compartments.

The shell plating includes a flat plate keel, 35 inches by 26.25 pounds, and seven strakes amidship on each side. The garboard strake *A* and strake *D* are 22.5 pounds, *B, C, E* and *F* are 20 pounds, and the sheer strake *G* is 30 pounds. The plating between the main and spar decks is 12.5 pounds for the lower strake and 10.2 pounds for the upper. The center vertical keelson is 27 inches by 18.75 pounds, with double 5-inch by 3½-inch by 12-pound angles, top and bottom.

FIG. 2.—STATEROOM DE LUXE ON THE ALABAMA.

FIG. 1.—THE GOODRICH TRANSIT COMPANY'S NEW PASSENGER STEAMER ALABAMA.

The frames are 6 inches by 13.75 pounds bulb angles, spaced 24 inches, and running to the main deck. Belt frames of 12-inch by 20.5-pound channels, spaced 12 feet apart, run continuously to the spar deck. The main deck beams are channels, 12 inches by 25 pounds, spaced 4 feet. The orlop decks are all steel, and the beams are exceptionally heavy to stiffen the ship for ice work. The bow plating is made of double thickness for the same purpose. The main deck is 15-pound plate, laid flush and covered in the cargo space with 3-inch fir decking.

Supporting the cabin or spar deck are channel belt beams, 12 inches by 25 pounds, spaced 12 feet, and terminating on the belt frames. These beams, in turn, support three I-beam fore and afters. The deck beams are 5-inch by 6.5-pound channels, spaced 3 feet. This deck is laid throughout with No. 10 W. G. plate, to serve as fire protection between the cargo space and the cabins. The 1⅜-inch matched deck is laid on battens on the steel.

The deckhands are berthed on the orlop deck, in the No. 2 compartment, which has asbestos composition floor and steel berths. The No. 3 compartment contains the galley and refrigerators on the starboard side, floored with brick. On the port side are the mess rooms and rooms for the cook's crew. These rooms are floored with composition. All partitions in the hold are of corrugated iron, with an open space at the top fitted with wire netting screens. The waiters are placed in the No. 7 compartment, with floors and partitions similar to those forward.

The firemen, coalpassers and sailors are housed on the main deck forward, the after partition between the quarters and the cargo space being of steel.

The main deck aft contains the lobby, baggage room, news stand, barber shop, purser's and steward's offices and the men's toilet. The lobby is finished in vermilion wood, with the borders of the panels enriched with inlay, and a marble base board protects the wood work at the bottom. The floor is asbestos composition, with an art border. The purser's and steward's offices are paneled in mahogany and equipped for their purpose; except for the toilet, which is ceiled in birch, all other rooms are finished in white enamel.

The grand staircase leads up the main salon, which is paneled in African mahogany. The panels are particularly large, extending from door to door of staterooms, and are built of beautiful crotch mahogany with inlaid borders on an inlaid figure, showing a conventional design of the cotton plant. The cotton plant, which is associated with the name Alabama, is used throughout the ship as the motif of the design. At the after end of the engine trunk, and directly facing the stairway, is a large panel showing the coat of arms of the State of Alabama, worked in inlay. This appears at a distance as a painting, and only close inspection shows that it is built up of many kinds of wood, each of its natural color.

At each side of the machinery trunk, and leading forward, is a wide passage finished in mahogany and terminating in the dining room. The stateroom numbers throughout are inlaid in the doors and enclosed by a border of the cotton plant.

The dining room extends 38 feet fore and aft and from side to side of the boat, with special rectangular windows, instead of the usual side lights. This room is finished in Prima Vera, an African wood, and is stained a beautiful shade of light green. The panels between the windows and on the other walls as well are inlaid with a spray of the cotton plant. At the after end is an imposing side board, built in, of the same wood, and in each after corner is a private dining room, one finished in cocoa wood, the other in Circassian walnut.

Forward of the dining room is the pantry, officers' mess, and rooms for the forward deck crew. The wireless room opens into the dining room, where messages may be filed and received.

On the promenade deck the entire cabin is given up to staterooms, which are finished in old ivory enamel and mahogany doors. On this deck there are two public bath rooms, one for men and one for women. The promenade itself is especially wide and can accommodate hundreds of people without crowding.

At the forward end of the boat deck is the large pilot house, with a flying bridge similar to those on ocean liners. The pilot house is placed aft of the foremast, and some distance from the bow. Just aft of the pilot house are the captain's quarters, finished in birch, natural finish. The balance of the forward cabin is devoted to six parlor rooms, with a bath room in connection with each room. These rooms are about 11 feet by 12 feet, and are furnished with brass beds, couches, and dressers, and each suite is decorated differently.

FIG. 3.—FORWARD END OF MAIN SALOON.
FIG. 5.—MAIN DECK.

FIG. 4.—SMOKING ROOM.
FIG. 6.—DINING SALOON.

Aft of the stack are staterooms and rooms for the cabin maids. The after end of the cabin is used for a large buffet, which is finished in Hungarian ash, stained a silver gray, bringing out the beautiful grain of the wood to the best advantage. There are eight alcove seats, with leather upholstering at the sides of the room. Four paintings of woodland scenes are worked into the panels between the windows. The bar is at the forward end, and there are two large refrigerators in connection. Double doors lead from the buffet to an Welin quadrant davits. The Alabama is the first boat on the Great Lakes to be equipped entirely with these improved davits. A sprinkler system in all parts of the ship, besides thermostats in every room and elsewhere, augment the regular fire system, which is operated by a large vertical fire pump of the fire boat type. Push buttons and thermostats operate annunciators in the purser's room, engine room and on the bridge.

The steering gear is the Williamson differential type, di-

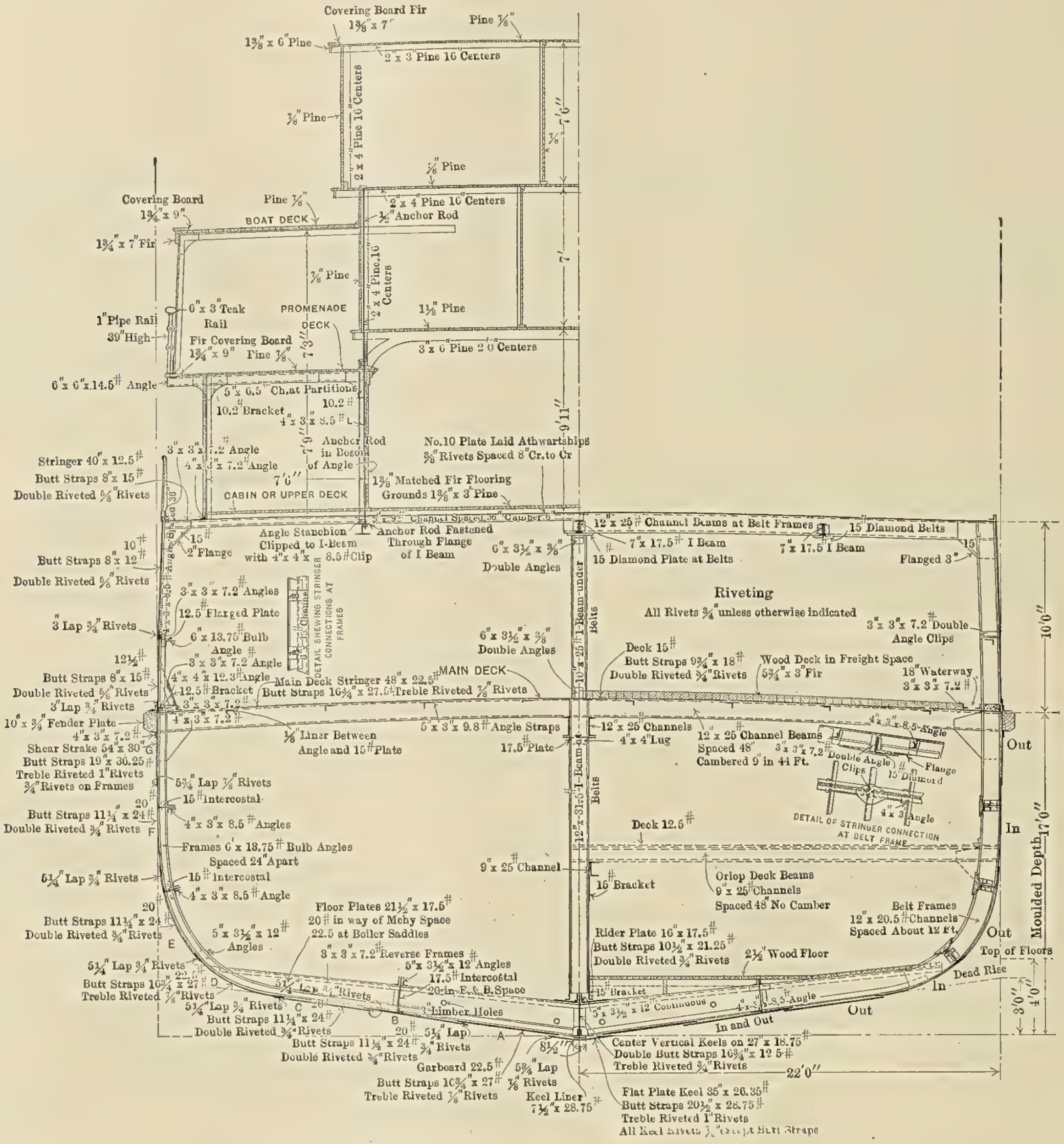


FIG. 7.—MIDSHIP SECTION OF THE ALABAMA SHOWING MAIN SCANTLINGS.

observation deck, where an unobstructed view of half the horizon may be enjoyed.

All of the toilets, bath rooms and crew's rooms throughout the ship are laid with asbestos composition flooring, which is seamless, sanitary and practically impervious to wear. The hallways and buffet are floored with cork tile, which is noiseless. The designing of the cabins was put in the hands of Mr. Abner Crossman, of Chicago, who before retiring was a leading decorator of that city.

The Alabama is equipped throughout with all the latest improved appliances for the safe-guarding of the passengers against fire and the elements, including A-B-C life belts and 12 large metallic lifeboats of the standard Lane and DeGroot type, equipped with Mills releasing gear and operated by rectly attached to the rudder stock, and the valves are operated by the Williamson telemotor. This steam machine is supplemented by a hand-gear, located on top the upper deck, aft.

The electric plant consists of three 35 kilowatt General Electric Company's turbine generators, operating 1,500 incandescent lamps and a 5,000-candlepower searchlight. There are two freight elevators of the hydraulic type, with platforms 8 feet square.

The propelling machinery consists of one triple expansion engine, with cylinders 23 inches, 38 inches and 62 inches diameter, with a stroke of 36 inches. The wheel is 12 feet in diameter, and has four adjustable blades. The driving shaft is 12½ inches diameter. The engine operates at 120 revolutions per minute, and develops 2,250 horsepower.

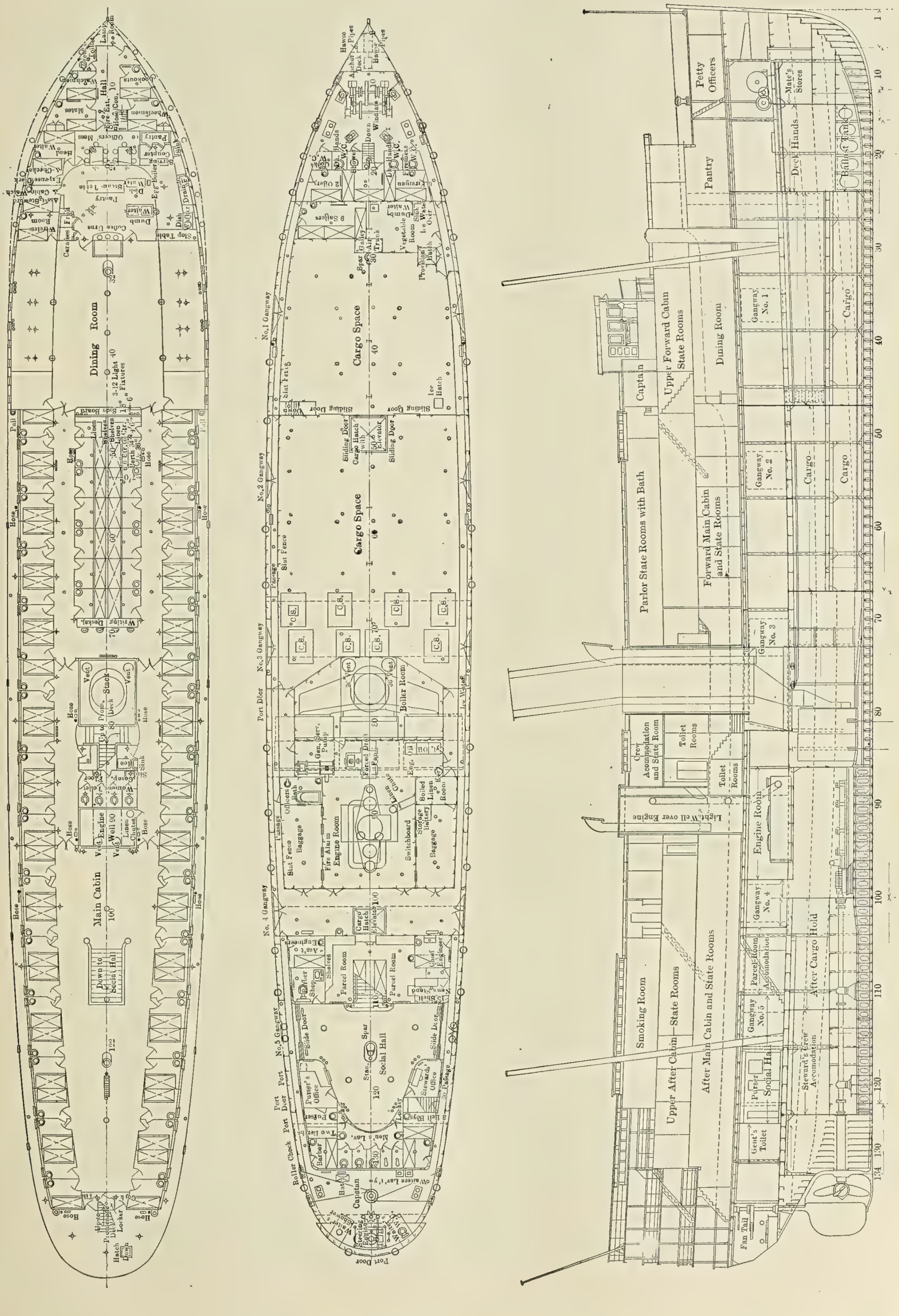


FIG. 8.—INBOARD PROFILE, MAIN AND SPAR DECK PLANS OF THE ALABAMA, SHOWING GENERAL ARRANGEMENT OF PASSENGER AND CARGO ACCOMMODATIONS.

The condensing outfit includes a surface condenser, with an area of 3,000 square feet, a centrifugal pump, with an 8-inch double suction, direct-connected to a 6-inch by 6-inch engine, and a 16-inch by 32-inch Prat Rotrex air pump.

The auxiliaries consist of a feed pump, general service pump, bilge, sanitary and fresh-water pumps, and Ahren's 10-inch by 6-inch by 8-inch vertical fire pump and two 30-inch water filters.

The refrigerating plant is the carbonic anhydride process, and the machine is installed in the engine room and piped to the various refrigerators in all parts of the ship.

The boiler installation consists of a battery of three Scotch marine boilers, 12 feet 6 inches diameter and 11 feet long, carrying 180 pounds of steam. The boilers are placed three abreast across the ship, with a common uptake, and there is a 12-foot firehold and an athwartship coal bunker. Each boiler has two 48-inch Morison furnaces, 286 3-inch tubes, 8 feet and 5/8 inch long. The grate surface is 48 square feet, and the heating surface 2,020 square feet for each boiler. The draft is a modified Howden system, operated by a 48-inch fan, direct-connected to a 7-inch by 7-inch engine, running 400 revolutions per minute. The fan is placed in the engine room on the main deck and tends to make the machinery space very comfortable.

Two 36-inch ventilators lead into the fire room, and, in conjunction with the single row of boilers, cause the firing space to be unusually cool.

Two new steamships, the *Luseric* and *Octeric,* with a combined tonnage of 30,000, have been placed in service by the Waterhouse Line on the route between Puget Sound, Japan, China and Manila, replacing the *Oceano* and *Aymeric.*

COALING WARSHIPS AT SEA.

Naval men, and all persons connected with the merchant marine, who have to handle coal or other bulk cargo in quantities, will find matter of interest in the recent performances of the new United States collier *Vestal* during a recent trip made for attendance upon the battleship *Michigan* and a fleet of destroyers on the coasts of Maine and Massachusetts. The entire fleet of United States colliers is built upon naval designs and equipped with the Spencer-Miller marine transfer, a device for the rapid transfer of coal, which was designed especially for this service and which now gives promise of becoming of considerable interest as an equipment for merchant ships of several classes.

The colliers differ materially one from another in details, but all are alike in the fact that they have large holds adapted to the use of grab buckets for taking out the cargo and hatches suitable for this method of unloading. There are two types of the Spencer-Miller marine transfer installed on them. On the vessels of the *Vulcan* type the booms are swung from king posts placed one on each side of the coal hatch. On the *Vestal* type, the booms are attached to masts, each mast carrying the booms to serve two hatches.

FIG. 1.—COLLIER VESTAL EQUIPPED WITH SPENCER-MILLER MARINE TRANSFERS, COALING A BATTLESHIP.

The *Vulcan* type had its first test in actual service much earlier in the year when the Atlantic fleet was at target practice off Guantanamo, Cuba, and the reports regarding the rapidity with which coal was transferred from collier to warship were most satisfactory. It was shown that the marine transfer would handle coal equally well with the grab bucket or in bags, and that it easily delivered coal to battleships faster than the crew of the battleship could dispose of it. The actual capacity shown in practice, where two trained operators

(Photograph Copyright, 1910, by Enrique Muller.)

FIG. 2.—U. S. COLLIER VESTAL.

transferred 190 tons of coal an hour from a single hatch, was at no time called for, as the crew of the battleships could not dispose of the coal at any such rate. Nearly 1,700 tons of coal was actually put aboard one battleship in five hours using four marine transfer outfits with grab buckets, and one handling coal in bags. This was declared to be a record performance under the circumstances.

The *Vestal* coaled the *Michigan* three times during the recent trip off the coast of Maine. There was no opportunity for testing the continued capacity of the transfer apparatus nor its total capacity, as, on account of experiments which were being conducted, it was necessary to keep the *Michigan* upon a practically constant load line. Therefore only quantities of from 250 to 350 tons were put aboard her each time. These quantities were, however, delivered in record time.

Some of the most interesting operations were in coaling torpedo boat destroyers. These little vessels could take only

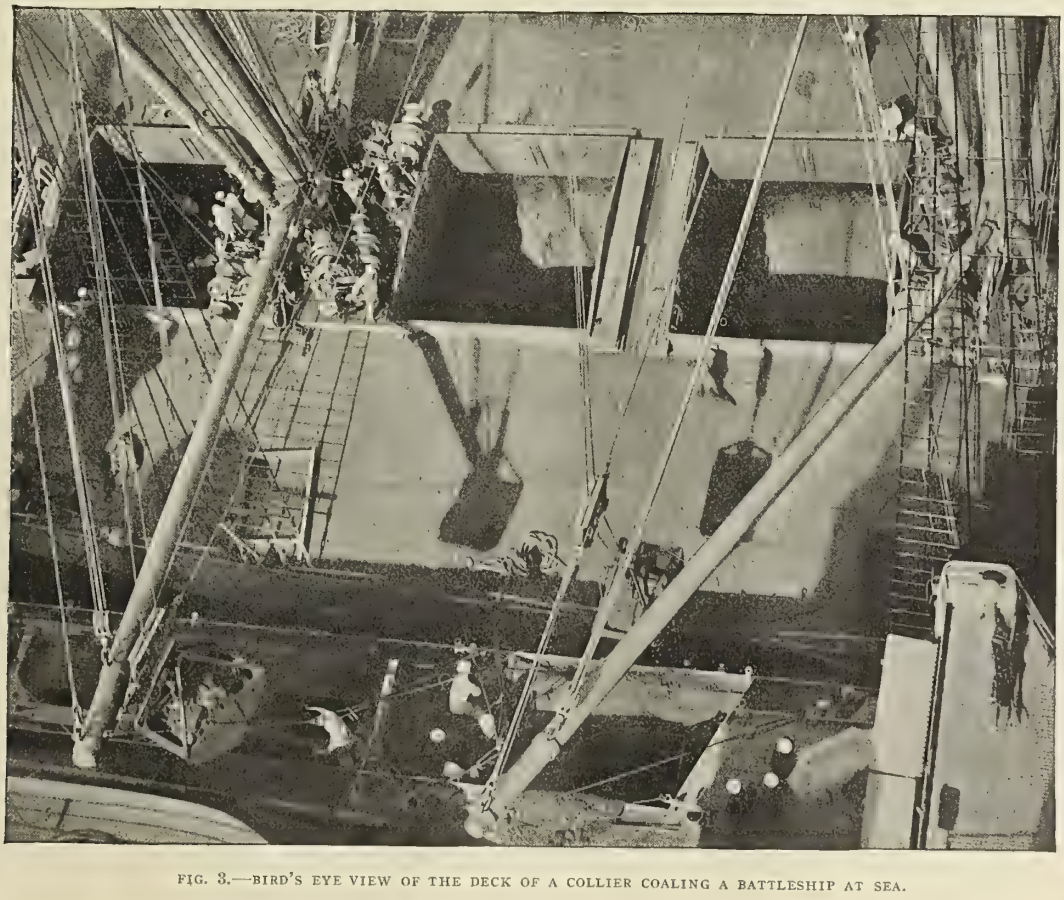


FIG. 3.—BIRD'S EYE VIEW OF THE DECK OF A COLLIER COALING A BATTLESHIP AT SEA.

about 40 tons at a time, but they were provided with a cluster of chutes from the deck to the bunkers, so that they could dispose of the coal rapidly. Notwithstanding their facilities for getting the coal below a single marine transfer with a 1-ton grab bucket was able to deliver the coal faster than it could be disposed of on the destroyers. Torpedo boats were repeatedly coaled with a 40-ton supply in twenty minutes.

These tests indicate very clearly that some modifications will have to be made in the design of modern war vessels, to enable them to dispose rapidly of the coal deposited on deck from colliers when coaling at sea.

THE NEW WHALING BRIG VIOLA.

One of the most notable additions to the American merchant marine this season is the new whaling brigantine *Viola*, recently completed at the shipyard of Messrs. James & Tarr, Essex, Mass. The new vessel is 125 feet long, 26 feet 1 inch wide, and 12 feet ½ inch in depth, the gross tonnage being 190 and carpenter tonnage 307. The frames are of white oak, sided 8 inches and are double, the planking being of the best white oak, 2½ and 3½ inches in thickness, butt fastened with copper spike fasteners. The inner sheathing is of yellow pine, 3 and 4 inches, and the deck is laid with 4-inch white pine, the beams being of oak, 8 inches square. The sheathing on the outside is of copper, three different weights being used, consuming over 4½ tons of copper sheathing and 1,100 pounds of copper nails; the hull beneath the copper sheathing is covered with felt.

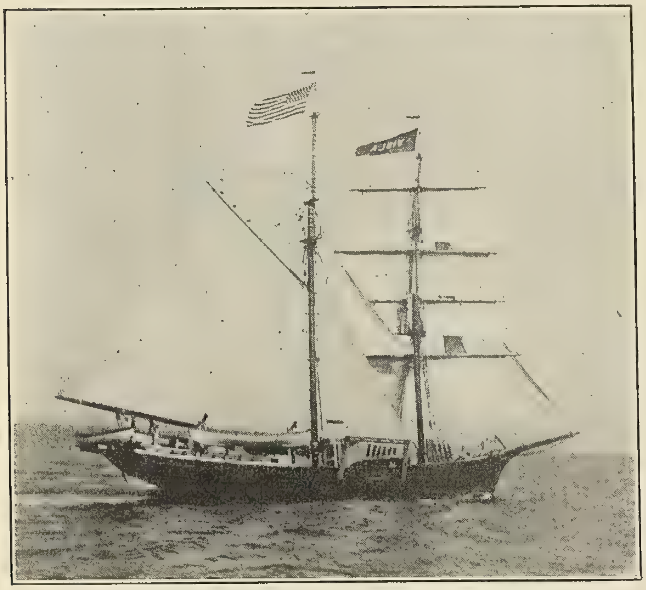


FIG. 1.—THE VIOLA LEAVING PORT ON HER FIRST VOYAGE.

The cabin is handsomely finished in cypress, with a hard pine floor, and is furnished with all modern conveniences, including baths, toilets, hot and cold water, both fresh and salt, etc. A unique feature of the cabin furniture is an ingenious combination sideboard, bureau, desk and medicine chest, making a splendid and useful addition to the cabin equipment. There is also a neatly constructed book cabinet and a sofa, built into the cabin woodwork in such a manner as to be economical of space, yet generous in accommodation. The entire equipment throughout this vessel is a decided innovation compared with the usual type of whaler, and there are many improvements of a radical nature, suggested by the many years of practical experience of her commander, Capt. John A. Cook, of Provincetown, under whose personal supervision she was built.

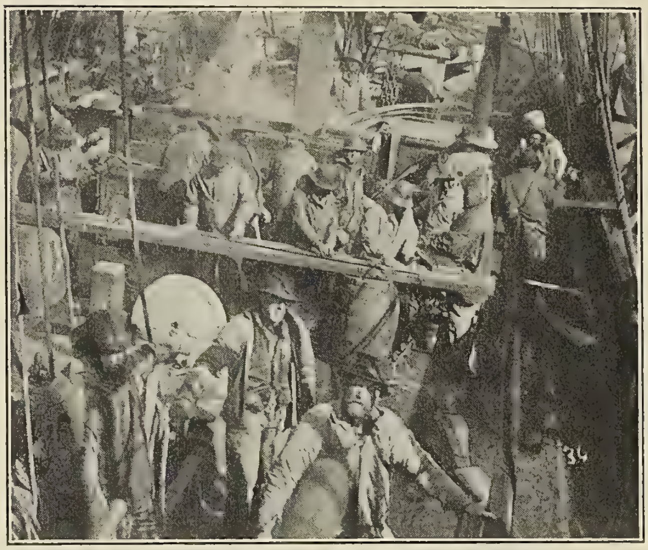


FIG. 2.—DECK SCENE, WASHING WHALE BONE.

The vessel is the property of the John A. Cook Whaling Company, Inc., of Portland, Me., but was fitted out and sails from the old whaling port of New Bedford, Mass., where the entire whaling fleet make their headquarters when in port.

The equipment for whaling includes four whaleboats—three carried on davits in readiness to lower, and one spare boat, carried on the stern. The apparatus for boiling out the oil from the blubber consists of two 165-gallon cast iron trypots, set side by side in a furnace of brickwork, built on deck just aft the foremast, and it is estimated that the vessel can stow about 900 barrels of oil in her hold. Everything about the vessel has had the best of material and workmanship, nothing but selected stock of the finest quality being used, and the work has been done with care and deliberation.

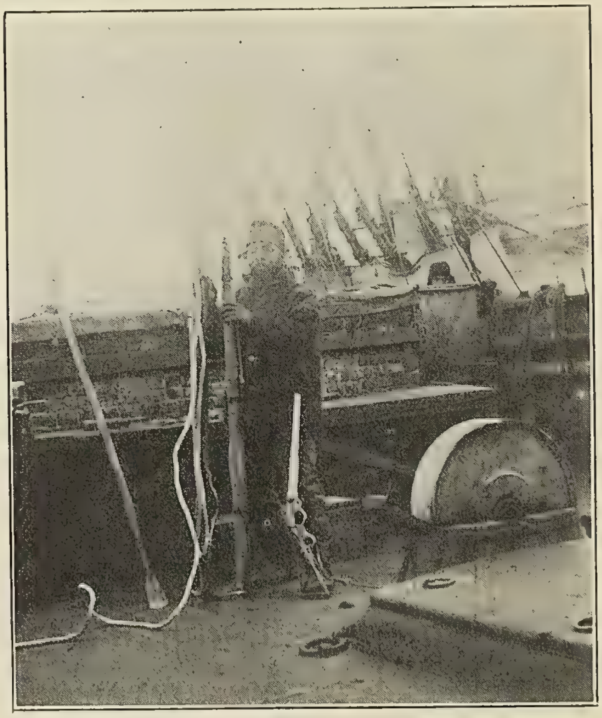


FIG. 3.—SAILOR WITH ALL HIS WHALING GEAR.

The craft conforms to Lloyd's regulations in every respect, and is rated by them A-1 for a period of fifteen years. Completed and ready for sea she is said to represent an outlay of about $45,000 (£9,260).

The accompanying views show the *Viola* as she appeared under sail for the first time, bound on a three years' voyage for sperm whales, and also typical deck scenes on board a whaler. The sail plan here reproduced gives a general idea of the sail area, as well as illustrating the arrangement of the whaleboats on the port side, there being but one carried on davits on the starboard side owing to the method of "cutting in," which is always done from the starboard gangway and cutting stage, which is lowered over the whale secured alongside, amidships. A unique feature of the rig is the introduction of a pole bowsprit, this being the only brigantine ever built so equipped, as far as known.

The vessel is provided with six large winches, ten large derricks and two extra heavy derricks for special lifts. Electric lights are fitted throughout, and there is a large refrigerating plant with cooling chambers.

The machinery, supplied by Messrs. David Rowan & Company, of Glasgow, consists of triple-expansion engines having cylinders 18 inches, 30 inches and 50 inches diameter by 33 inches stroke, and two single-ended boilers 13 feet diameter by 10 feet 6 inches long, designed for 180 pounds working pressure, natural draft.

The engine cylinders are supported on six columns, the back columns being of cast iron and the front ones of polished wrought iron. The condenser is of the built type, separate from the main structure of the engines, and is arranged with specially large surface for working in tropical waters. The air, circulating, feed and bilge pumps are of

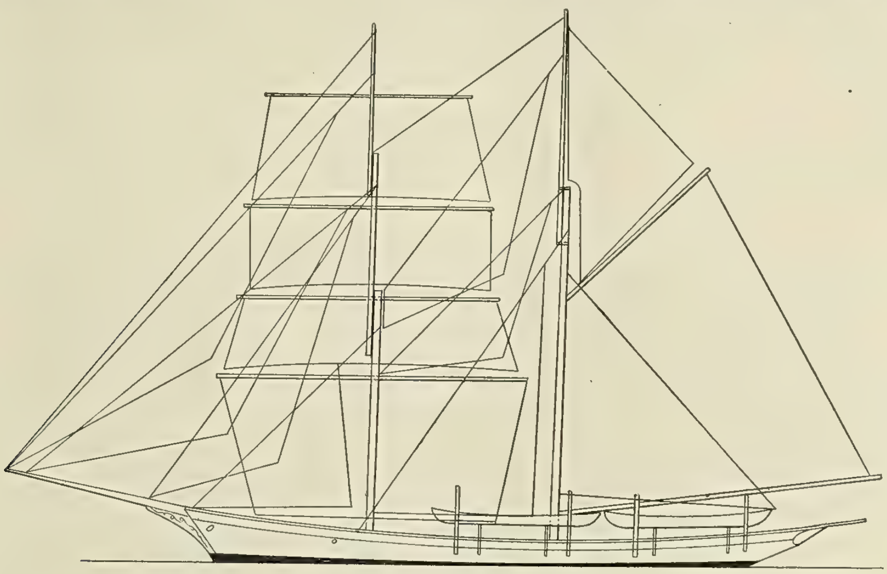


FIG. 4.—SAIL PLAN OF THE VIOLA.

the usual reciprocating type, driven by levers off the main engines.

This vessel has been built on the Isherwood system of longitudinal framing, to Lloyd's highest class, special survey,

The whaler will carry a crew of twenty-three men all told, including the captain, first, second and third mates. The craft was named *Viola* in honor of the captain's wife, and she has accompanied him on the long voyage as assistant navigator, as she has sailed with him previously for twelve years, and is considered to be an expert navigator.

The Jonathan Holt, Designed for West African Service.

Messrs. William Hamilton & Company, Ltd., Port Glasgow, launched in June, 1910, the *Jonathan Holt*, a handsomely modeled steel screw passenger and cargo steamer, built to the order of Messrs. John Holt & Company, Liverpool. The principal dimensions of the vessel are: Length, 260 feet 6 inches; beam, 38 feet; depth to main deck, 18 feet 3 inches; depth to shelter deck, 26 feet 9 inches.

This vessel is intended for the West African trade, and is rigged as a fore and aft schooner; she has a raised forecastle, with accommodation for native "kroo boys," and raised poop with accommodation for the white crew. Accommodation is provided in houses on the shelter deck for the captain, officers, engineers and passengers, and for a handsome saloon, smoking room, etc., etc. Special attention has been given to the ventilation of the vessel, electric fans being introduced. Mosquito screens have been fitted throughout.

LAUNCH OF THE JONATHAN HOLT.

and under the superintendence of Messrs. A. C. Hay & Smart, consulting engineers, Liverpool.

A special feature of this vessel is the attempt to make her mosquito-proof in tropical climates. The interior of the vessel is much roomier than the ordinary West African steamer. Every skylight and air aperture on the vessel has special coverings of closely-worked copper gauze. The port holes have double doors—an ordinary glass one for use in the temperate zone and a copper gauze one, which replaces the glass when the tropical zone is reached. There are similar double doors in the saloons of the vessel and in the sleeping quarters of the men.

OLD TRANSATLANTIC PACKET SHIPS.

BY FRANCIS B. C. BRADLEE.

Strange as it may seem to the present generation of travelers, the transatlantic trade some seventy-five years ago was dominated by sailing packets. As early as 1707 there were regular trading ships between Boston and London, some of the best-known captains of that period being Mason, Holberton and Sears. As the eighteenth century wore on Liverpool began to be substituted for London as the English port, the coarser and bulkier cargoes coming from Liverpool and the finer goods being shipped from London. Most of the coarse goods consisted of earthenware, iron ware, coal and salt. In the years just preceding the breaking out of the Revolution the best-known packets between Boston and England were the *Boston Packet,* Captain John Marshall, and the *London Packet,* Captain Robert Calef. Both of these vessels were not over 300 tons register apiece, and both were owned in Boston. During the Revolution and for some time after everything was in such a disorganized condition that, as far as can be traced, there were few regular traders to England.

In 1805 an association was formed in Boston called the Boston Importing Company. The company was to operate vessels, and also import and export goods, between Boston-Liverpool and London. J. W. Storrow was the treasurer of this concern, and Ammidon and Boyle were the agents. In May, 1805, they advertised the ship *Sally,* Captain Seth Webber, "intended for a regular ship between this port and Liverpool, 323 tons, coppered to the bends, and having elegant accommodation for passengers." This vessel and others named the *Packet* and the *Romeo* were run between Boston and Liverpool in 1806 by the Boston Importing Company.

Other regular traders, all American, of this period, to Liverpool, *not controlled* by the Boston Importing Company, were the *President Adams, New-Galen, John Adams, New Packet,* etc.

In addition to the ordinary dangers of the seas American commerce at this time was subjected to great annoyance, disaster and loss, in connection with the tremendous struggle then in progress between Great Britain and France. What with the British orders in council on the one hand and French decrees on the other (it is marvelous that the New England merchants were able to maintain their position on the ocean at all. The Boston Importing Company's ship *Sally* was "sequestered" at San Sebastian in 1810, but finally was released in order to bring home the American Minister to France, Gen. Armstrong. Owing to this and the fact that another of their ships, the *Packet,* had been seized for some time at Hamburg, the Boston Importing Company became involved in financial trouble and its affairs were settled.

The next effort to start a line of packets between America and England was when some New York merchants started the famous Black Ball line to Liverpool in 1816. Each vessel of this line had a large black ball painted on the foretopsail so it could be easily recognized at sea. The Black Ball line of packets was probably the best known of all, for it lasted under different managements until 1883, although it gave up carrying passengers ten years before that. Its last ship was the *Ne Plus Ultra,* of 1,300 tons, Captain Borden.

The first four ships of this line (1816) were the *New York, Canada, Pacific and Jas. Munroe,* each about 400 tons (considered large in those days) and full ship rigged. Their passenger accommodation was considered very fine and caused the old merchantmen to seem shabby and uninhabitable. These vessels sailed from either side regularly on the 1st of each month, and for the first nine years their average passage to the eastward was 23 days and westward 40 days, although the *Canada* once made the eastward passage in 15 days 18 hours.

NEW YORK AND LIVERPOOL PACKET SHIP ROSCIUS OF THE DRAMATIC LINE (1835).

BURNING OF THE WHITE DIAMOND LINE PACKET OCEAN MONARCH JUST OUTSIDE LIVERPOOL, AUGUST 24, 1848.

The Black Ball line gradually increased its sailings and vessels adding such ships as the *Oxford, Cambridge, Yorkshire, Devonshire, Independence* (which although built as far back as 1834, once made a voyage to Liverpool in 13 days) *Isaac Webb* and many others. The *Isaac Webb* was perhaps one of the best known of their vessels. She was built by Wm. H. Webb at New York in 1850 of live oak, locust and cedar, 188 feet long, 40 feet beam, and 28 feet depth, with three full decks and a registered tonnage of 1,300. She often made the voyage to Liverpool in 16 and 17 days.

THE MORGAN LINE PACKET SHIP VICTORIA (1843).

In 1821 Byrnes, Grimble & Co. started another Liverpool line called the Red Star, with ships called the *Panther, Hercules,* etc., and which sailed on the 24th of each month. Then followed the Swallow Tail line, with the *George Washington, Pennsylvania,* etc., and in 1836 Mr. E. K. Collins founded what was known as the Dramatic line, the ships of this line being named after celebrated actors, as the *Roscius, Siddons, Garrick* and *Shakespeare.* These vessels were considered very large for their day, being 1,000 tons or more each. A noted departure also in these ships besides their superior interior fittings was the total abandonment of the fine lined vessel having a sharp rise of floor and the substitution for it (against the opinion of the noted New York shipbuilders) of the flat floored form of hull. Mr. Collins afterwards founded the famous Collins line of steamers between New York and Liverpool in 1850, but it was unsuccessful.

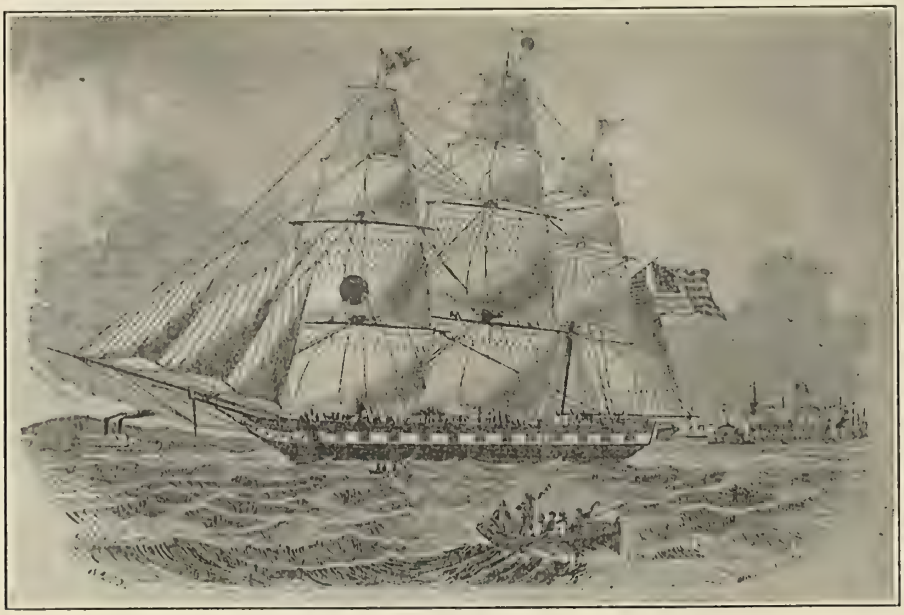
Other well-known lines of packets were Morgan's to London; Grinnell & Minturn's to London and Liverpool, owning the *Constitution, Cornelius Grinnell, etc.;* Williams & Guion's Black Star line to Liverpool, all from New York.

The *Adelaide* of the Black Star line in 1864, while on her way down New York harbor, was passed by the steamer *Sidon* of the Cunard line, but the *Adelaide* arrived in the Mersey before the *Sidon,* having made the passage in 12 days 8 hours.

In 1866 Messrs. Williams & Guion, finding it impossible to compete against steamships, built a line of steamers known as the Guion, but owing to the stringency of the United States laws, this line was operated under the English flag, although it was really entirely owned by American capital. The Guion line of steamers has been extinct only since 1894.

All of the packet ships belonging to the various lines were not, contrary to general opinion, of the "clipper" type, with the exception of the *Dreadnought, Racer* and a few others to be noticed later, the clippers being almost always built for the China, India and San Francisco trades. The packet ships were built with more or less round bows, full poops extending nearly to the mainmast, and great breadth of beam, thus insuring large carrying capacity combined with strength of hull. They were not intended for extreme speed, and when they did make rapid passages it was entirely owing to the good seamanship of the commanders in being able to carry a heavy press of canvas.

THE SOUTHAMPTON OF THE MORGAN LINE (1849).



THE ISAAC WEBB (1851) OF THE FAMOUS BLACK BALL LINE.

The packets conveyed higher grade cargoes, also cabin and steerage passengers. The former, with the captain and officers, were lodged under the poop, and although the cabins and saloon (or cuddy, as it used to be called) were then considered very fine and spacious, they would not compare with modern standards. Each ship had room for from 10 to 20 saloon and 500 to 1,000 steerage passengers, and these latter

were berthed in the 'tween decks. There was no ventilation, and in bad weather the steerage passengers would be driven below and the hatches would be clapped down upon them. Conditions then may better be imagined than described.

Steerage passengers had to provide their own bedding and do their own cooking, and the following was the bill of fare legally instituted for them by the British Government: Each adult to receive weekly as follows: 3½ pounds bread or biscuit not inferior in quality to navy biscuit; 1 pound flour, 1½ pounds oatmeal, 1½ pounds rice, 1½ pounds peas, 1¼ pounds beef, 1 pound pork, 2 pounds potatoes, 2 ounces tea, 1 pound sugar, ½ ounce mustard, ¼ ounce ground black pepper, 2 ounces salt, 1 gill vinegar.

Cabin passengers fared somewhat better, as may be seen by the following dinner bill of fare on board the *Cornelius Grinnell* on her way from New York to London in 1858: Soup, boiled cod with boiled potatoes, roast turkey, mashed turnips, roast and boiled potatoes, stewed chicken with macaroni, pie, hot rolls, sea pies and pickles, plum pudding.

The rates of passage varied, but the following may be taken as the average: Saloon, $150 (£31), and steerage from $25 to $40 (£5 to £8).

Probably the best known of the transatlantic packet ships was the celebrated *Dreadnought*, commanded by the equally celebrated Captain Samuel Samuels. The *Dreadnought* was built at Newburyport, Mass., in 1853, and was of 1,400 tons register. She was what might be termed a semi-clipper, and as Captain Samuels says in his book "From the Forecastle to the Cabin," possessed the merit to bear driving as long as her sails and spars would stand. Twice she carried the latest news to Europe, slipping in between the steamers. Her cabin accommodation was generally engaged a season in advance, and freight by her was guaranteed to be delivered within a certain time or freight charges forfeited. The *Dreadnought* was built for the Red Cross line of packets, to run in conjunction with the *Racer, Driver, Highflyer* and *St. Patrick*, but, strange to say, every one of these vessels was lost through one cause or another, leaving the *Dreadnought* all alone on the line. She made the passage from Liverpool to New York, dock to dock, in December, 1854, in 13 days, 11 hours, and in 1860 she capped the climax and reached Queenstown in 9 days and 17 hours from New York, a feat never equalled before or since by any sailing vessel.

Captain Samuels always attributed his fast passages to good discipline and forcing the ship at night as well as during the day. Of course, all voyages were not always fast. In the winter and spring, owing to the prevalence of westerly gales, it was not uncommon for the packet ships to be 50, 60, or even 70 days in reaching New York. The *Switzerland*, of Grinnell's line, was once 110 days on the voyage.

The crews of the transatlantic packets (or "packet rats," as they were called), were never noted for tender qualities. Captain Samuels says of them: "They were the toughest class of men in all respects, and could stand the worst weather, food and usage, and put up with less sleep, more rum and harder knocks than any other sailors. They would not sail in any other trade." In August, 1859, the *Dreadnought* was the scene of a serious mutiny and the ship had to be worked for several days by Captain Samuels and his officers alone, but at last the crew was overawed by stern measures and loaded firearms.

CLIPPER SHIP DREADNOUGHT (1854) OF THE RED CROSS LINE OFF TUSKAN LIGHT.

In February, 1862, the *Dreadnought*, while on her way to New York, encountered a severe gale, lost her rudder, and Captain Samuels broke his leg. For several days the ship lay in the trough of the sea quite unmanageable. They were 600 miles from Fayal, and being unable to keep the ship's head to the sea, Captain Samuels managed to back her 280 miles. In the meantime a jury rudder was rigged and the vessel finally arrived safely at Fayal, where she remained several months.

The *Dreadnought* was finally forced out of the transatlantic trade by the steamers and ran for some years between New York and San Francisco; she was totally wrecked near San Francisco in 1869. Captain Samuels occupied a number of responsible positions ashore for a number of years, and finally died in Brooklyn in May, 1908, aged nearly 90.

In 1821 the Boston and Liverpool Packet Company was organized in Boston. They tried to get a charter from the Legislature and failed, but nevertheless ran several ships, including the *Amethyst, Topaz* and *Sapphire*, between Boston and Liverpool, but the enterprise soon failed. Very little can be found out about it.

In 1827 another Liverpool packet line was organized in

Boston by Henry Hall, Joshua Blake, David Henshaw and others. They also tried to get a charter from the Legislature, but failed. Nevertheless, they had built for them at Medford, by Thatcher Magoun, several ships of the highest class—the *New England, Lowell, Trenton, Plymouth, Boston* and the *Liverpool*—all between 400 and 500 tons. Jabez Howes was the best-known captain on the line, and Geo. G. Jones was the agent, and, according to the advertisement, "mattresses, bedding, wines and all other stores were to be furnished to passengers in the cabin, and for them the fare to Liverpool was to be $140 (£29). The packet *Boston* belonging to this line was struck by lightning and burnt May 26, 1830, a few days out from Charleston, S. C., on her way to Liverpool. Sir Isaac Coffin, the Boston boy who rose to the position of admiral in the British Navy, was a passenger. This packet line ceased operations (probably owing to hard times) about 1833, as no trace of it can be found after that date.

The first line of packets to Havre from New York was started in 1822 by Francis Depan with ships named the *Stephania,* Captain John B. Pell; *Henry IV.,* Captain Wm. W. Skiddy, and *Helen Mar,* Captain Harrison. Other lines to Havre were started in 1823 by John J. Boyd, and in 1832 by Wm. Whitlock, Jr.

In 1844 Mr. Enoch Train started his *celebrated and by far the best known* line of Boston and Liverpool packet ships. The first ships advertised by the new line were the *Dorchester,* 500 tons; the *Cairo,* 600 tons; the *Governor Davis,* 800 tons, and the St. Petersburg, 800 tons, "all first class Medford-built, copper-fastened, coppered and fast-sailing ships." Mr. Train afterward added to his fleet the following vessels: *Joshua Bates, Anglo-Saxon, Anglo-American, Washington Irving, Ocean Monarch, Parliament, Daniel Webster, Star of Empire, Chariot of Fame, Staffordshire, Cathedral* and the *John Eliot Thayer.* All these latter ships were built by the celebrated Donald McKay at East Boston, and were large for their day, ranging from 1,000 to 1,500 tons each. They were especially designed for the emigrant trade.

The *Ocean Monarch* of this line met with a very sad fate. She left Liverpool for Boston August 24, 1848, under command of Captain James Murdock, with 32 cabin, 322 steerage passengers and a crew of 42 on board. Soon after the tug had left her outside Liverpool she was discovered to be on fire, owing, it is said, to one of the steerage passengers lighting a fire in a ventilator. As she had just left port, more or less confusion prevailed and part of the crew were drunk. According to Captain Murdock's own account, "We began without delay to throw water down, but five minutes afterwards—indeed almost instantly—the after part of the ship burst into flames. We put the ship before the wind in order to lessen the draft, but were obliged to bring her to again. The fire produced the utmost confusion among the passengers, desperation prevailed, yells and screams of the most horrifying description were uttered, all control over them was lost; my voice could not be heard, nor my orders obeyed."

To make a long story short, the *Ocean Monarch* burnt so rapidly that in spite of several ships being near at hand and sending assistance at once (among which may be mentioned the new Brazilian frigate *Alfonso,* which was on her trial trip with the Prince de Joinville, son of the ex-King of France, Louis Phillipe on board), 178 persons lost their lives either by burning or drowning. At a court of inquiry Captain Murdock was exonerated from all blame.

The sketch of the burning ship (page 375) is from the sketch book of the Prince de Joinville himself.

Probably the best known of all Train's ships was the *Staffordshire,* built by Donald McKay in 1851. She was 240 feet long, 41 feet beam, 37 feet depth, and registered nearly 2,000 tons. She was full clipper type and very fast. She was lost on the Nova Scotia coast December 30, 1853.

The *Staffordshire* was commanded by Captain Josiah Richardson, and when the ship went ashore he said: "My passengers first, my crew next, and then my officers, and I will stay by my ship," and he went down with her. Captain Richardson was a native of Shrewsbury, Mass., and there is a monument erected to his memory in the beautiful cemetery of that town.

Other well-known captains in the "White Diamond" line, as Mr. Train's line was called, were: Caldwell, Thayer, Brown, Howard and Knowles. The present Warren line of steamers, although sailing under the English flag, is the outcome of the Train line of packet ships. After Mr. Train died the firm became Thayer & Warren, and then Warren & Co.

Another well-known "White Diamond" packet was the *Daniel Webster,* built in 1850 to replace the *Ocean Monarch.* She was built by Donald McKay at East Boston, in the strongest and best manner of white and live oak, at a cost of $80,000 (£16,500), 1,500 tons register, 186 feet long, 40 feet beam. She had a full poop extending nearly to the mainmast, under which was the saloon and first-class cabins. The saloon was described as a "spacious apartment, fitted elegantly in rich, deep-veined mahogany, with columns relieved with gold. The ceiling is white and gold." The emigrants' quarters were a great improvement over anything then existing, being fitted up with iron berths and two hospitals, the latter a great novelty.

The captain of a packet was a much more important personage than a Cunard captain is to-day. He was an owner as well as a commander, and he met the shipping merchants on terms of social equality. He was absolute master of his vessel and of every man on board of her. His income was often $5,000 (£1,030) a year, consisting of 5 percent of all the freight money, 5 percent of all steerage passage money, 25 percent of all cabin passage money, the entire receipts for carrying the mails (2 pence a letter from the British Government and 2 cents a letter from the American Government), and a salary of $360 (£74) per annum. Moreover, he had the privilege of taking his wife, and sometimes even her sister aboard free. A packet captain also attended personally to the lading, rigging, victualling, manning and many other details of a ship's orderly departure, superintending and paying for repairs and keeping a regular business account with the agents as one merchant does with another.

For a time after the steamers started the packets held their own, but the introduction of iron, screw-propelled steamers carrying freight and emigrants at reduced rates sounded their death knell, and by 1875 few were left, and these had given up carrying passengers. The Black Ball line in 1847 placed a steamship in service, the *United States,* built by Wm. H. Webb at New York. She was a large, wooden side-wheel boat of nearly 2,000 tons, but soon after she came out the company accepted a tempting offer for her from the Prussian Government, and she was made into a steam frigate.

It is rather a painful contrast to present American deep water shipping conditions, to think that previous to the introduction of steamers in the transatlantic trade (1838) the United States controlled nearly the whole of this vast traffic. With the exception of the Hamburg-American line of German packets, now the Hamburg-American line of steamers, *every line of packets* was under *the American Flag.* To-day there are *four* American transatlantic steamers, and, of course, no sailing vessels at all. *There was not a single line of English packet ships,* whereas to-day Great Britain stands supreme in the deep sea carrying trade.

Lieutenant Commander Roscoe C. Moody and Lieutenant Commander Milton E. Reed have been detailed for permanent duty as designing engineers in the Bureau of Steam Engineering, United States Navy.

THE MARINE STEAM ENGINE INDICATOR—XIV.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

THE DIAGRAM.

In the preceding chapters an attempt has been made to describe the indicator, to point out the most widely differing details of the various designs, to describe methods of testing and keeping the instrument and its reducing gear in order and to give directions for the proper manipulation of the mechanisms when taking diagrams. It now remains to show just what the diagram is, what may be deduced from it and the most common errors to which it is liable. Very few have sufficient comprehension to gather any clear idea of the relation between two or more variable quantities when these quantities are represented by figures only, and to make such relations clearer mathematicians have long made use of graphic diagrams, certain forms of which will now be described.

A thorough understanding of simple graphic diagrams is a necessity for every marine engineer who would advance in the theoretical part of his profession, because the technical press contains an ever-increasing number of them, and in indicator work a knowledge of simple graphics is absolutely essential. The reader is therefore urged to make a few of these diagrams for himself, using any tables which he may have at hand and which contain two sets of variable quantities.

The system about to be described was originated by Descartes in 1637, and hence is called the *Cartesian System* in

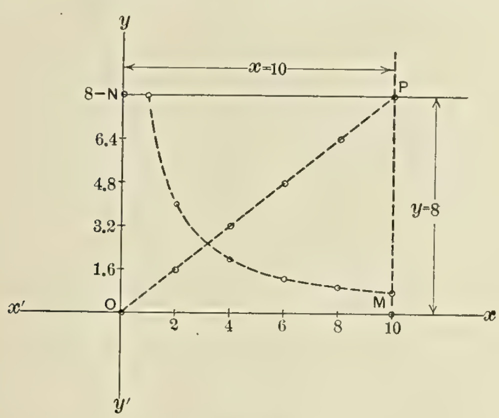


FIG. 93.

honor of its inventor, and the simple forms here shown are the starting point of *co-ordinate* or *analytic geometry*.

Upon a sheet of paper draw a horizontal line $x'x$, and intersecting it at right angles at the point O a straight vertical line, $y'y$, as in Fig. 93. The line $x'x$ is known as the *Axis of Abscissæ*, or *Axis of X*, and the line $y'y$ as the *Axis of Ordinates*, or *Axis of Y*. The point O in which the lines intersect is called the *Origin*. The two lines when spoken of together are called *Co-ordinate Axes*, and the term rectangular is sometimes prefixed because the axes are at right angles. If through the point P we draw PM parallel to $y'y$, and PN parallel to $x'x$, it is at once plain that the position P is known if the lengths PM and PN are known; that is to say, when the value of its co-ordinates are known. Distances measured on or parallel to $x'x$ are usually referred to as the distance X and distances measured on or parallel to $y'y$ as the distance Y. Suppose that P is 10 inches to the right of the axis of Y and 8 inches above the axis of X. The *Equations of the Point* are $x = 10$ and $y = 8$. The distance 10 is also known as the absicssa of the point P and the distance 8 as the ordinate.

* Copyright, 1910, by Chas. S. Root.

The equations for the point N are $y = 8$, $x = O$, and for the point M, $x = 10$, $y = O$.

Draw a line from O to P. The *equation of the line is*, $y = .8x$. Assign any value to x, as 2, 4, 6, 8, 10, as shown in the figure. Mutliply these numbers by .8 and we get the following results for values of y:

When X is	2	4	6	8	10
Y is	1.6	3.2	4.8	6.4	8.0

Locate the points whose equation are $x = 2$, $y = 1.6$; $x = 4$, $y = 3.2$. A straight line will pass through the origin, the points located from the equations, and the point P. The reader should verify this statement by constructing the diagram. This line is technically known as a curve, no matter what its form.

[1] Take the equation $x\,y = 8$. To trace this curve divide both sides of the equation by x and we have the equation in the form $y = \frac{8}{x}$. Let $x = 1, 2, 4, 6$, as before and solve to determine a set of values for y as given below:

When X is	1	2	4	6	8	10
Y is	$\frac{8}{1}$ or 8	$\frac{8}{2}$ or 4	$\frac{8}{4}$ or 2	$\frac{8}{6}$ or 1.3	$\frac{8}{8}$ or 1	$\frac{8}{10}$ or .8

Locate the points and draw the curve. This curve is a rectangular hyperbola and is much used in the analysis of indicator diagrams.

Before taking up the indicator diagram two examples of the practical use of graphic diagrams will be given, this in order to show the very clear manner in which more or less obscure relations between variables are indicated. Consider the following quantities taken from the steam tables of Marks and Davis[2] showing the relation between the pressure and temperature of saturated steam:

Absolute Pressure Lbs. per Square Inch Also Values of x.	Temperature Degrees Fahr. Also Values of y.	Absolute Pressure Lbs. per Square Inch Also Values of x.	Temperature Degrees Fahr. Also Values of y.
20	228	120	341.3
40	267.3	140	353.1
60	292.7	160	363.6
80	312.	180	373.1
100	327.8	200	381.9

An inspection of the above table will enable us, at best, to obtain only a hazy idea of the relation which exists between the columns of variable quantities. To make the relation clearer lay down a graphic diagram as follows:

Every engineer should have on hand a few sheets of co-ordinate paper, ruled 10 x 10 to the half inch, with every tenth line in both directions a little heavier than the rest, as shown in Fig. 94.[3] Let each single division horizontally represent one pound pressure above absolute vacuum and mark every ten pounds with figures along the axis of X. Let each vertical division be one degree Fahrenheit (commencing at the axis of X with 100 degrees) and mark every ten degrees with figures along the axis of Y. Locate the point $x = 20$, $y = 228$, as shown at 1 in the figure, then $x = 30$, $y = 267.3$, as at 2. Fix the remaining points given in the table, as shown at 3, 4, 5, 6, 7, 8, 9 and 10, and pass a smooth curve through them. An inspection of the curve shows that the slope is about 45 degrees between 60 and 80 pounds absolute, and in consequence that the temperature increases about one degree for each pound increase in pressure. That between 20 and 30 the increase in temperature is about two degrees for every pound increase in pressure, and between 160 and 180 pounds the increase is only one-half degree per pound. No simple equation which will satisfy this curve is known to the writer.

It will be noticed that pressures and temperatures intermediate to those used in laying out the curve can be readily

[1] The reading of this paragraph may be omitted if the solution and the equations is not clear to the reader.

[2] Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam. Longmans, Green & Co., 1909.

[3] This paper is usually known as "Cross Section" paper in the United States and "Squared" paper in Great Britain. Sheets of the best quality with the outside dimensions of the ruling about 5 inches by 7-½ inches can be obtained for 25 cents (1 shilling) per quire.

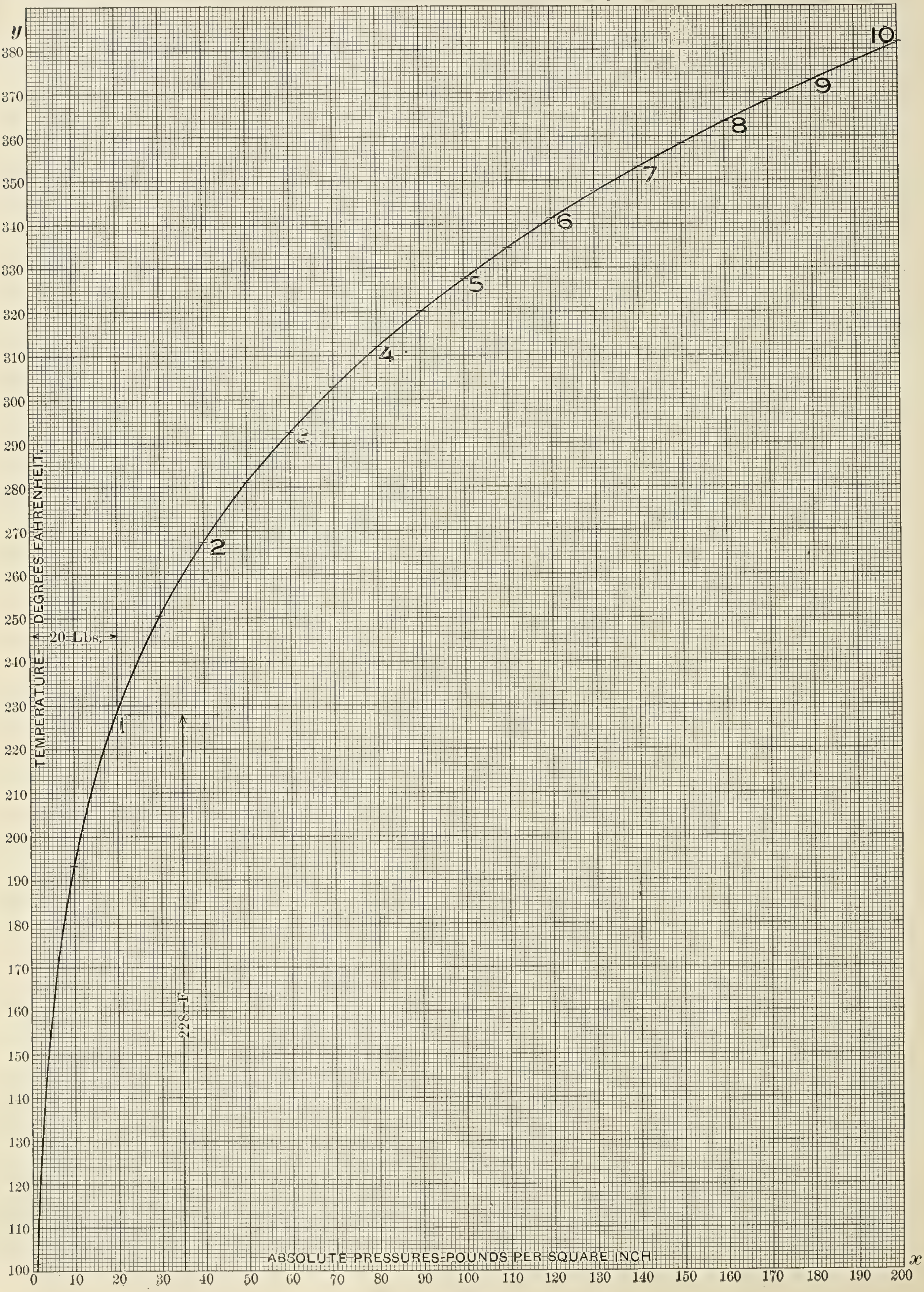

y
x
TEMPERATURE DEGREES FAHRENHEIT.
ABSOLUTE PRESSURES-POUNDS PER SQUARE INCH.
20 Lbs.
228° F.
1
2
3
4
5
6
7
8
9
10
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200

FIG. 94.

taken from the diagram and this with a close degree of accuracy. If the curve had been run through points located by actual observation during a test of pressure and temperature, and any point had fallen much outside of the smooth curve, attention would at once have been called to the discrepancy, and the observation either thrown out or re-verified. This is another advantage of a graphic log.

Graphic diagrams are frequently made use of by marine engineers for displacement curves; speed and horsepower; speed and revolutions; speed and coal consumption; mean effective pressure; revolutions and horsepower, etc. etc.

In order to illustrate the action of the steam in an engine cylinder let us suppose that we have a condensing engine as follows: Stroke, 50 inches; steam admission cut-off at 15 inches on the down stroke; the exhaust opening at 48 inches. On the up-stroke the exhaust is closed when the piston is 3 inches from the top, and the lead is such that steam is again admitted when the piston is ½ inch from the top. The pressure in the valve chest is 30 pounds above absolute vacuum, and the vacuum gage attached to the condenser reads 26 inches, corresponding to 2 pounds absolute pressure. For the sake of simplicity suppose the engine to be without clearance. The cylinder diameter is omitted, as it does not concern us at present.

Let the axis of X (Fig. 95) represent zero pressure, and the axis of Y zero volume, the top of the piston being against this latter line when the engine is on the top center. Let us suppose that the piston on its up-stroke has reached the point $x = ½$; the steam valve opens, and by the time the piston has reached the top center ($x = O$) the steam pressure has run up to equal that in the valve chest, or 30 pounds ($y = 30$). Mark the point $x = O$, $y = 30$, as shown at B. The piston now commences its downward stroke, represented on the diagram by motion from left to right. The steam valve is open and the pressure remains equal to that in the valve chest. When the piston has moved downward 15 inches the admission of steam is suddenly stopped. This point is indicated at C ($x = 15$, $y = 30$). As the steam supply is cut off, and the piston still going down, the pressure falls proportionately as the volume increases, the graphic representation of the combined pressure and volume being approximately a portion of an hyperbola. Observe that the pressure multiplied by the volume at the point C is 15 x 30, or 450, which gives us as an equation for this hyperbola $x \times y = 450$. By dividing this constant number by the value of x (the completed stroke at any point) we obtain the value of y (the pressure) at the corresponding point. At the point $x = 30$ the volume is twice as great as at C, and the pressure one-half, or 15 pounds. At 45 inches the volume is three times as great and the pressure one-third, or 10 pounds. At the point D ($x = 48$, $y = 9.37$) the valve opens to exhaust, and the pressure above the piston falls rapidly towards condenser pressure. By the time the crank pin crosses the bottom center the pressure has dropped to that of the condenser at E ($x = 50$, $y = 2$). The up-stroke begins here, represented on the diagram by motion from right to left, with the pressure equal to that in the condenser. When the piston has completed 47 inches of its upward stroke, and is within 3 inches of the top, the exhaust port is closed, as indicated at F ($x = 4$, $y = 2$). The rising piston compresses the imprisoned steam, and the pressure runs up as shown in the figure. At A ($x = ½$, $y = 12$) the valve opens to steam and the cycle is complete. Notice that at F the volume is 3 and the pressure 2, and the product of the volume times the pressure is 6 ($x \times y = 6$). To find the pressure at any other point divide the constant 6 by the volume x. Thus at $x = 2$ the pressure is 3, at $x = 1$ the pressure is 6, and at $x = ½$, the point at which the valve opens to steam the pressure has risen to 12 pounds.

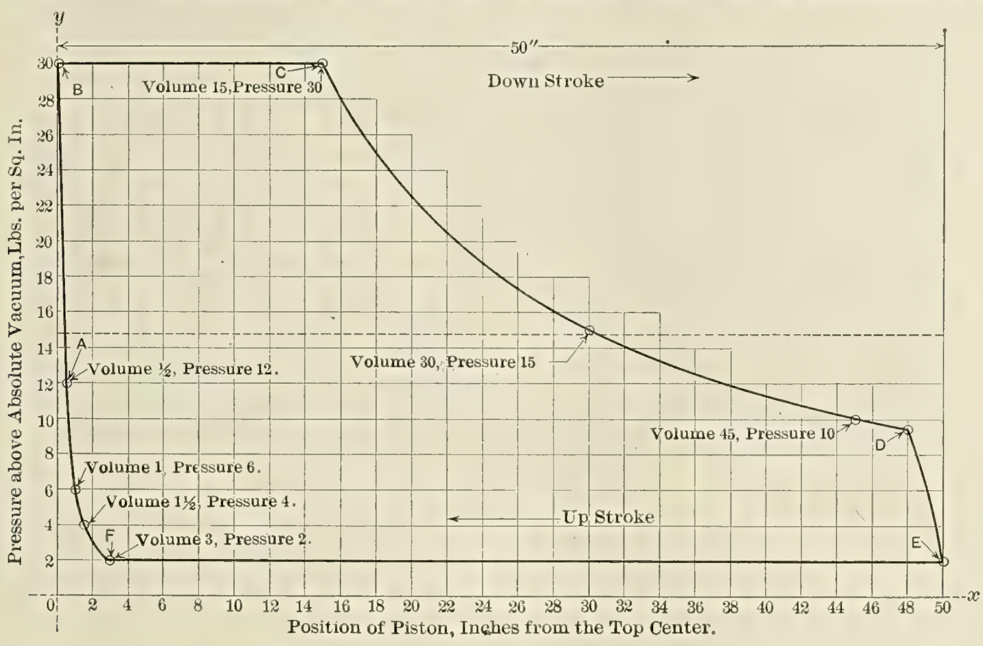


FIG. 95.

To go over the cycle again: A is the *point of admission; AB* the *admission line; BC* the *steam line; C* the *point of cut-off; CD* the *expansion line,* or *expansion curve; D* the *point of release; DE* the *exhaust line; EF* the *counter-pressure* or *back-pressure line; F* the *point of compression* or *point of exhaust closure,* and *FA* the *compression line* or *compression curve.*

If instead of steam the engine were moved by a perfect gas, acting in a cylinder and against a piston made of non-conducting material, and in addition if the valves opened and closed instantly, the ports being so large that there was no friction and the engine was without clearance, the diagram of Fig. 95 would be drawn by a perfect indicator.

The actual diagram, as drawn by the instrument, will vary from the theoretical to a greater or less degree at every line and point, and the extent of this variation is the basis of diagram analysis. From a diagram carefully and properly made by correct instruments we can determine the sufficiency of

the steam pipes, steam ports and passages for admission and exhaust; the adequacy of the valve gear relative to the time of the admission, cut-off, release and compression, and whether or not the valves move as rapidly as they should during opening and closing. The percentage of vacuum realized in the low-pressure cylinder is shown, and taken in connection with other data the power exerted on the piston can be computed and the consumption of steam closely estimated.

In connection with the diagrams certain *reference lines* are used and are defined as follows:

The *zero line of pressure*, or line of absolute vacuum, is the axis of X in Fig. 95, and represents a perfect vacuum or absence of all pressure. It is located by scale from the atmospheric line drawn by the indicator.

The *atmospheric line* is 14 7/10 pounds above the zero line of pressure with the barometer standing at 29.92 inches. It is indicated in Fig. 95 by the broken line at the proper height above the axis of X. The *vacuum line* is parallel to the atmospheric line and a distance below it equal to the vacuum indicated by the condenser gage.

The *line of boiler pressure*, or *line of receiver pressure*, is a line drawn parallel to the atmospheric line located by scale measurement at a distance above it equal to the reading of a pressure gage attached to the boiler or space from which the engine takes steam. On cards from intermediate and low-pressure cylinders this line shows the average receiver pressure.

The *clearance line*, or line of zero volume, is the axis of Y in Fig. 95. This engine was supposed to be without clearance. If the clearance had been 10 percent the axis of Y would have been 10 percent of 50, or 5 points farther to the left of that shown in the figure. Note that clearance is of two kinds —*linear clearance*, which means the distance in linear measure between the piston and cylinder top or bottom when the engine is on the center, and *volumetric clearance*, meaning the total *volume*, in cubic measure, between the piston and cylinder ends, plus the ports and passages, clear to the valve. In indicator work volumetric clearance is always understood unless otherwise noted.

(*To be continued.*)

The new United States oil-burning destroyer Paulding, recently completed by the Bath Iron Works, Bath, Me., averaged 33.07 knots for five runs over the Owl's Head course on her standardization trials.

Repairs to the J. T. Morse.

The steamer *J. T. Morse*, of the Eastern Steamship Company, running between Rockland and Bar Harbor, Me., built by William McKie, at East Boston in 1904, was sunk recently at her dock by the turbine steamer *Belfast*, owned by the same company. After being floated the *Morse* was towed to Camden, Me., and hauled out on a railway and temporarily patched, the repairs being sufficient to enable her to proceed to Boston. She arrived at Boston under her own steam, where she was hauled out and found to have a hole 20 feet long, cut through to her keelsons. This required six new frames on her starboard side, twenty-four streaks of plank and ceiling, new keelsons and a complete calking. All her lower joiner work was removed and replaced by new work, and the carpets and furniture were renewed and the machinery overhauled. The work was completed by William McKie in two weeks, and the steamer was again placed on her route.

STEAMER J. T. MORSE, AFTER BEING RAMMED BY THE BELFAST.

Cruise of the Salmon.

Recently the United States submarine *Salmon* made a voyage from the yards of the Fore River Shipbuilding Company, Quincy, Mass., to Hamilton, Bermuda, and return. This vessel is one of the latest types of American submarines, and is 134 feet 6 inches long by 15 feet diameter. When running at the surface she displaces 230 tons and in a submerged condition 345 tons. Her speed, as determined on her official trials, is 13¼ knots, and on her twenty-four-hour surface trial she averaged 12¼ knots.

The *Salmon* left Quincy on July 5 with twenty-one persons aboard. On the cruise a distance of 1,514 miles was covered, and 7,250 gallons of gasoline (petrol) were used. While in Bermuda her gasoline tanks were replenished and a few minor repairs were made. The *Salmon* returned to Quincy on July 17 in perfect condition. The voyage out was made on an average speed of 7.8 knots. A faulty cylinder gasket on one of the engines necessitated running under one engine alone during part of the voyage. On her return trip, with both engines operating satisfactorily, the speed was 9.7 knots.

It was intended that the boat should make the voyage unattended, but the underwriters insisted upon sending a tug with the boat upon the outward voyage. That no convoy was necessary, and that the submarine proved seaworthy and habitable in all kinds of weather, strongly emphasizes the increasing importance of the modern submarine as an adjunct to a seagoing battleship fleet.

SHALLOW DRAFT POWER CRUISER.

The power yacht Madge III., recently built by the Charles Ward Engineering Works, of Charleston, W. Va., for Mr. Charles Ward, involves some unusual features of design. The hull, designed especially for cruising on the inland rivers, is 86 feet 6 inches long, 11 feet molded beam, 15 feet over the guards, 3 feet 9 inches deep, with a draft of 2 feet, including the propeller. The hull is finely modeled, and built of No. 12 BWG steel plates. The frames are 1¼ by 1¼ by 3/16-inch steel angles, and there are four water-tight bulkheads.

The deck is of 1 inch white pine, calked and painted. The forward deck is 13 feet long, with guards 2 feet wide, and the after-deck and cockpit 12 feet 6 inches long, under a standing roof, with brass railing 28 inches high around the entire boat.

The cabin or deck house is 60 feet 6 inches long, built of teak and arranged as follows: Forward is a cabin or dining room with circular front, 9 feet 9 inches by 13 feet, with folding table and two extension seats, making berths 30 inches wide. Immediately aft is a lavatory and toilet, with passage between leading to galley, which is 3 feet 9 inches by 10 feet 4 inches, fitted with china closet, plate racks, refrigerator, Shipmate range, sink, hot and cold water, shelves, etc., with doors to the dining room and deck. Aft of the galley are two staterooms 6 feet long, with two berths in each, the entrance being from the deck. The engine room is 10 feet 6 inches by 13 feet 6 inches, with room for three berths and a toilet for the crew.

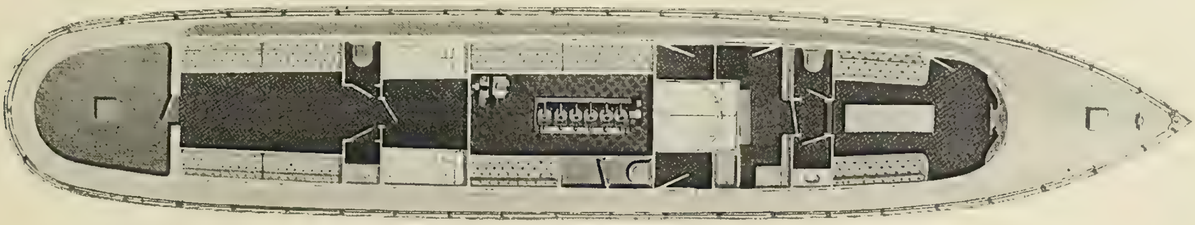
The owner's stateroom, 6 feet 3 inches by 10 feet 5 inches, is located aft of the engine room and has two stationary berths, a dresser and drawers under one berth. A full-length mirror is placed in the door to the after-cabin. A toilet room is located just aft of the owner's stateroom, with a passage between the after-cabin, which is 10 feet by 12 feet, and fitted with four extension pullman berths, with an entrance from the after-cockpit.

The walls, bulkheads, doors and sashes are of mahogany; the ceiling and carlins of clear white pine. All sashes are glazed with plate glass and arranged to drop, except in lavatories, where they are hinged at the bottom. The cushions are of the best quality plush, filled with Ostermoor elastic felt, and the curtains are if silver gray velour, with roller blinds and carpet. The boat has in all sleeping accommodations for 12 people, not including three berths in the engine room.

The motive power consists of a 125 horsepower six-cylinder Standard gasoline (petrol) engine, air starting and reversible, driving a bronze propeller 36 inches in diameter, which works in a tunnel formed in the stern of the boat. Gasoline (petrol) tanks are located in the engine room under the berths and in closed compartments, which are seamless steel tanks of 425 gallons capacity. The floor and bulkheads in the engine room are of steel. The electric plant is a Standard combination outfit driving a 1½ kilowat direct current generator, with water service and air pump and a searchlight on the pilot house. The boat is steered from the forward cabin, the pilot wheel being conveniently located at the forward end.

The deck fittings consist of one hand capstan on the forward deck. Access to the propeller is gained through a hatch

LARGE SHALLOW DRAFT POWER YACHT MADGE III.



PLAN VIEW OF THE MADGE III.

in the after cockpit floor and top of the tunnel, thus allowing the propeller to be removed and replaced without docking or employing a diver.

The speed of the boat as determined by the mean of two runs up and down stream is 15 miles per hour.

Loss of the British Cruiser Bedford.

Just as we are going to press news is received of the total loss of the British cruiser *Bedford*, which went ashore on the rocks off Quelpart Island, Korea, during speed trials between Formosa and Korea. Eighteen members of the engine room staff lost their lives, due to the sudden inrush of water, which filled the hull up to the engine room bulkhead. It is reported that there was a thick fog at the time of the accident.

The *Bedford* is 440 feet long on the waterline, 66 feet beam with a mean draft of 24 feet 6 inches. Her normal displacement is 9,800 tons, and on her eight-hour full-power trial she attained a speed of 22.7 knots, her engines developing 22,457 horsepower. She is driven by two sets of four-cylinder, vertical triple-expansion engines, and is armed with fourteen 6-inch guns and eight 12-pounders, besides smaller guns and two submerged torpedo tubes. Her side armor is 4 inches thick, and that on the barbettes 5 inches. She was laid down at Fairfield in 1900, and completed in 1903.

Race for the British International Motor Boat Trophy.

The annual race for the British International Trophy, or Harmsworth trophy, was held Aug. 20 over a 30-mile course on Long Island Sound. Two American boats, *Dixie II.* and *Nameless,* and two British motor boats, *Pioneer* and *Zigarella,* started. The *Zigarella* was first over the line and the *Dixie II.* and *Pioneer* three seconds behind her, and the *Nameless* some distance in the rear. The *Pioneer* quickly outdistanced all of her competitors and proved herself by far the fastest boat, but after gaining a lead of about a mile she became disabled by the clogging of her intake pipe, and before the difficulty could be overcome the *Dixie* had passed the disabled boat and gained such a lead that she easily won the race. The *Dixie's* average speed for the entire course was 34.7 statute miles an hour.

Condition of Machinery on Vessels of the United States Atlantic Fleet.

In the annual report of Rear Admiral Schroeder, U. S. N., commander-in-chief of the Atlantic fleet, interesting reference is made to the condition of the machinery and boilers of the various ships. The machinery and boilers of all ships are reported in good condition with the exception of the boilers of the *Ohio, Maine* and *New Jersey,* which, while these ships were with the fleet, were in poor condition. The standardization and full power trials which were held last winter in connection with the steaming efficiency competition under what might be considered average service conditions, resulted in a highly creditable performance of the fleet as a whole with the exception of the *Vermont, Rhode Island* and *New Jersey.* These ships failed to attain their contract speed through the unreliability of their feed pumps. In the *Connecticut* class the ships, save the *Vermont,* greatly exceeded the contract speed. In the *Virginia* and *Idaho* classes, save the *Rhode Island* and *New Jersey,* the contract speed was averaged, and the performance of the *Wisconsin* and *Missouri* was equally creditable when their age is considered.

Rear Admiral Schroeder comments on the steadily increasing tendency to make the ships self-sustaining, two ships, the *New Hampshire* and *Idaho,* having asked for nothing in the cognizance of the Bureau of Steam Engineering. Not only have repairs been effected in a large measure on board the ships themselves, but some things have been undertaken which are directed toward increase in efficiency over the original design. In this connection, Rear Admiral Schroeder refers to the valuable service rendered by the repair ship *Panther* during target practice and while at the navy yard in New York.

An exhaustive examination has been made by a board of inspection of the three measured mile trial courses over which United States vessels are given their official trials. Varying depths of water, conditions of tide, etc., affect the speed of the vessels so that different results are obtained when the ships are tried over the different courses. As a result of the investigation it has been decided that the Rockland (Me.) course is the best for all purposes; that the Provincetown (Mass.) course is the next best and the Delaware Breakwater course the least desirable, largely on account of the current prevailing in those waters.

It is reported that an experimental tank for testing ship models is to be constructed by Messrs. Vickers' Sons & Maxim at Barrow-in-Furness. At the present time only two private shipbuilding firms in Great Britain have thoroughly equipped model testing basins. These are Messrs. Denny and Messrs. John Brown. The great advantage gained by the use of such a tank in the design of ships makes the establishment of such apparatus almost a necessity in a large shipyard where a variety of work is done unless access can be had to a government tank.

The Lamport & Holt Line, which has been maintaining a fortnightly passenger service between New York and Rio de Janeiro, with a monthly service between New York and Buenos Ayres, has under construction three new ships, which, with the vesels now in service, will be used to maintain a fortnightly service between New York and Buenos Ayres by way of Rio de Janeiro. The new ships are to be 510 feet long, 61 feet beam, and of approximately 12,000 tons gross. They will be twin-screw vessels with a speed of 14 knots.

According to a press dispatch, the new 32,000-ton battleship which is being built by Armstrong, Whitworth & Company for the Brazilian government, will be 655 feet long over all, 96 feet beam and 26 feet draft. The armament will consist of twelve 14-inch guns, fourteen 6-inch and fourteen 4-inch guns, besides three 18-inch submerged torpedo tubes. The contract speed is to be 22½ knots.

The United States battleship *Delaware* made 21.5 knots on her recent four-hour full-speed trial, and averaged 19.74 knots on her twenty-four hour endurance run. The contract for this vessel required an average speed of 21 knots for four hours and 19 knots for twenty-four hours.

The German naval programme for 1911, as at present outlined, includes three battleships and one supplementary ship under the Novelle of 1908, and another cruiser battleship. Besides the capital ships the programme also includes two small cruisers, twelve destroyers and a number of submarines.

The new Cunard liner *Franconia* was launched recently by Swan, Hunter & Wigham Richardson, Ltd. She is 625 feet long over all, 72 feet beam, with a gross tonnage of 18,000. She will be propelled by twin screws driven by quadruple expansion reciprocating engines of about 14,000 indicated horsepower.

A New Combination Steamer.

The *Rotorua,* launched by Messrs. William Denny & Bros., Dumbarton, on July 12, is another notable example of the combination steamer. Besides being the largest steamer ever built at Dumbarton, she is also the second to be fitted with the new combination of reciprocating and turbine engines. The *Otaki,* the pioneer steamer of this type, was also built at Dumbarton, and for the same owners—the New Zealand Shipping Company of London.

The vessel is propelled by two sets of direct-acting, triple expansion engines and an exhaust turbine of the Parsons type. She is of steel, built under survey of the British Corporation. Her length, between perpendiculars, is 484 feet; breadth molded, 62 feet, and depth to upper deck, 35 feet.

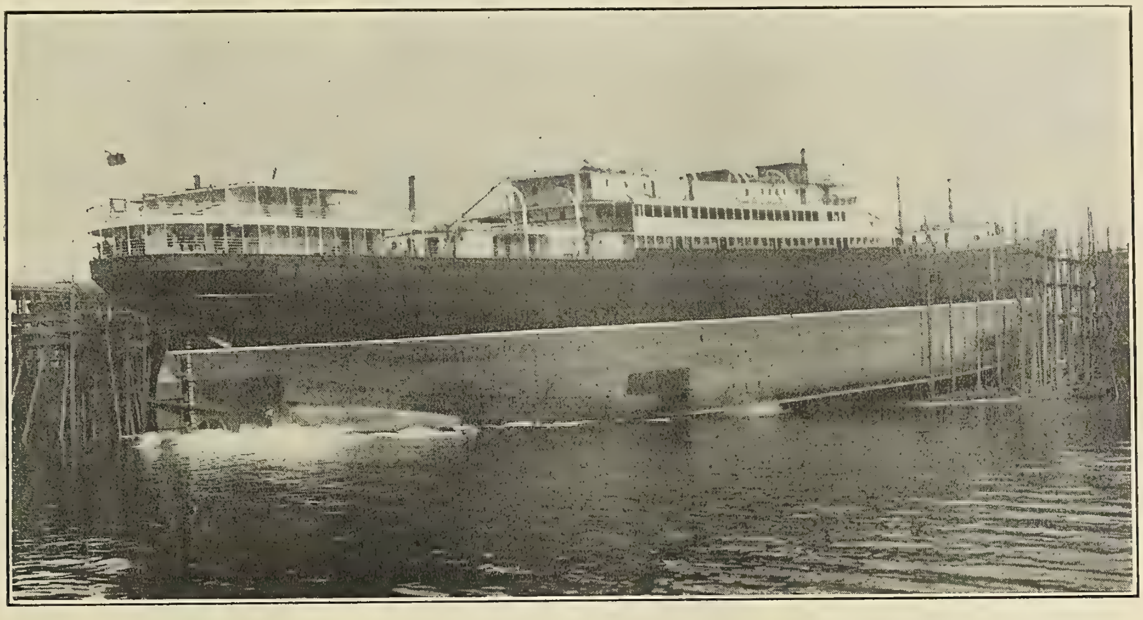
At the extreme fore end of the upper deck there is accommodation for seamen and firemen, and abaft this the storerooms and powerful refrigerating plant necessary to maintain a suitable temperature in the large insulated holds. Abaft the machinery space is the accommodation for the second-class passengers, who are provided with roomy cabins, having two, three, or four berths. Abaft this again is accommodation for third-class passengers, in two and four berth rooms, every room having natural lighting, in addition to electric lighting. On the shelter deck forward are deckhouses for the officers and stewards.

The midship portion is devoted to the accommodation of first-class passengers. The large midship deckhouse has at its forward end the first-class dining saloon. The framing is of stained and waxed oak in a classic design. In the after-end of this deckhouse is the second-class dining saloon, which is finished in white enamel, with mahogany furniture. There are eight large dining tables, with most of the seats on the revolving pattern.

Abreast the main mast is a deckhouse containing accommodation for the engineers. Above the shelter deck is a promenade deck for first and second-class, containing at the forward end the first-class lounge, vestibule and a number of special staterooms. The lounge is a spacious apartment designed in Adam's style and finished in ivory white. At the after-end is the second-class lounge and companion. The lounge is finished in white enamel, with mahogany furniture. Above the promenade deck and protecting it from the weather is a boat deck on which is the social hall. It is framed in oak, stained and waxed. On the other side of the companion is the first-class smoking room generally similar to the social hall and a play room for children. At the after-end of the boat dack is the second-class smoke room, panelled in polished lacewood.

Above the boat deck is the navigating bridge, containing chart room and wheelhouse, and fitted with all the latest appliances in navigating instruments, telegraphs, telephones and telemotor controlling the steering gear. This last is of the spring tiller pattern, so as to relieve the gear from all shocks.

The vessel is fitted with a complete installation of cargo gear capable of dealing with weights up to 25 tons. A number of cargo ports are fitted to facilitate the rapid handling of frozen meat, for the conveyance of which the entire fore-end of the vessel is insulated.



LAUNCH OF THE ROTURA; THE LATEST VESSEL TO USE THE COMBINATION OF PISTON AND TURBINE ENGINES.

Loss of the Perry.

The United States revenue cutter *Perry* was wrecked on Tonki Point, St. Paul Island, one of the Pribilof group of the sealing islands in Behring Sea, on July 26. The *Perry* was engaged in patroling these islands for the protection of the seal herds from the raids of Japanese poachers. There are no lighthouses, fog signals, buoys or other aids to navigation on these islands, and the strong current which sweeps around them carried the *Perry* ashore on a dangerous reef during a heavy fog. The *Perry* was 161 feet long, the smallest vessel of the patrol fleet. She was built in 1884 at Buffalo, N. Y., and was originally assigned to duty on the Great Lakes. In 1893 she was transferred to the Pacific Coast. In over fifty years this is only the second revenue cutter which has ever become a total wreck. The other loss was that of the *Gallatin,* which was lost in January, 1892, by striking a reef while attempting to enter Gloucester harbor in a blinding snowstorm.

The Bureau of Navigation reports that 124 sail and steam vessels of 38,372 gross tons were built in the United States, and officially numbered during the month of July, 1910. Nine steel steamers of 16,799 total gross tons were built on the Atlantic and Gulf coasts, and nine steel steamers of 18,139 total gross tons were built on the Great Lakes.

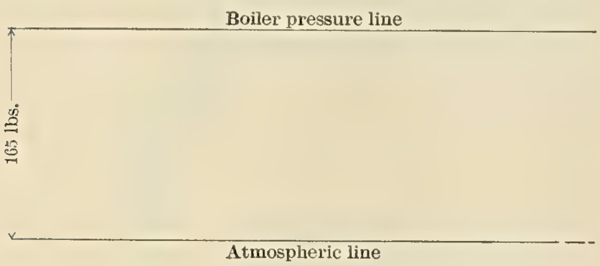
PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Indicating a Boiler.

It not infrequently happens in plants having a number of boilers in a battery or series of batteries, each fitted with from one to four safety valves and one steam gage, that there is a difference of from one to five pounds pressure in the point at which the safety valves lift. This means that the valve having the spring with the lightest tension will be the one that lifts whenever the steam reaches a higher point than that set for safety, and, in many cases, some safety valves are never lifted unless by some mechanical means installed for that purpose.

At the same time, perhaps, no two steam gages in the plant show the same pressure or correspond with the point of blow-off of the safety valves. This, of course, is not a desirable condition. The obvious and proper thing to do would be to



INDICATOR CARD FROM A BOILER.

summon an inspector, who, with a test gage, would set each safety valve on each boiler separately, and correct the error in the steam gages.

But in cases where a test gage is not immediately available the same desired result can be obtained by means of an engine indicator by the following method:

Having ascertained that the indicator is perfectly accurate, have pipe fittings of a suitable size connected to the steam space of each boiler. Cut out the boiler, having valves to be tested, from the battery, gag all safety valves on that boiler except the one to be tested. Attach the indicator in the usual manner, after having blown steam through the pipes to clear any dirt or grit that may have been in them. Raise steam slowly in the boiler until it reaches the blowing-off point. Then, after placing the paper on the drum of the indicator in the usual manner, open the cock to the atmosphere, and, while holding the pencil against the paper on the drum with one hand, pull the cord with the other hand, thus drawing the atmospheric line. Then, after the indicator has been properly warmed by admitting and releasing steam to the cylinder by means of the cock, open the cock full, admitting the full boiler pressure, then draw a second line in the same manner as before described. This line will be the boiler pressure line. Then by measuring with the scale suitable for the spring used on the indicator, the distance between the two lines will give the pressure on the boiler at the point at which the valve being tested blows off. If no scale is available, measure the distance between the lines in inches and fractions thereof, and multiply by the number of the spring used on the indicator.

This operation can be done in a very few minutes, and as each valve is corrected the reading of the steam gage on the corresponding boiler should be noted and corrected, the operation to be repeated on each valve of each boiler until each valve blows off at the point allowed by law, and each steam gage gives an accurate reading. W. K. Q.

How a Spare Propeller and Shaft were Fitted at Sea.

We were on a voyage from Bombay to Dundee, Scotland, in ballast trim, when our ship lost its propeller through the breaking of the tail shaft, just outside the stern tube. As the vessel was in the Indian Ocean, near some very inhospitable islands, the inhabitants of which are noted for their man-eating propensities, and as a strong current was setting towards those islands, our captain and chief engineer determined to attempt to fit the spare propeller and tail shaft which we had in the hold. This feat we managed to accomplish under very trying conditions, but in an entirely satisfactory manner. In order to prevent the vessel from drifting and rolling, a sea anchor, consisting of a long derrick having sails weighted with chains attached to it, was let out, and, as a further preventative, one of the anchors, with 30 fathoms of chain cable, was lowered away. This lessened the leeway considerably, but, owing to the boisterous, squally weather, the vessel continued to roll easily during all the time we were replacing the propeller and tail shaft.

While the captain and his officers were making preparations for lifting and slinging the propeller, the chief engineer and his staff were very busy down below disconnecting the shafting, and chocking it up. They also rolled the intermediate length to one side, and made it fast there. Our next job was to cut a plate off the tunnel top, and, as it turned out, it was a very difficult job, owing to its being an inside plate. Finally, however, all was made ready for removing the broken shaft. The propeller was then unshipped in the hold and lowered away on to the floor of the hold, with, of course, the large end of the bore up. Having done this, we lifted the spare shaft on end and tried it in the bore of the propeller boss. We had previous to this taken every precaution to see that the taper and key were a good fit. All being now ready for fitting the propeller and shaft, orders were given to fill the fore peak, tanks and fore hold, the water in the latter being only up to the outside level of the water.

After this was done, we started to get the broken shaft in, and after about 12 hours' solid work we managed to land it into No. 4 hold. A wooden plug was fitted to the shaft hole on the outside. This kept nearly all the water out. Our next job was to get the new shaft into place. This job took us 24 hours' solid work to finish; we had to make a Muntz metal cap, to go over and protect the threads on the nut end of the shaft. This Muntz metal cap was run out flush, with the guard ring pushing the wooden plug out at the same time.

Everything now being ready for fitting the propeller, the difficult and dangerous operation of lifting a mass of metal of over 8 tons over the side of the vessel and passing it under the stern had to be accomplished while the vessel was rolling in the trough of the sea, which was a very heavy one at the time, and which also prohibited the use of either boats or rafts.

As all the hatches were fitted with two derricks, both derricks were utilized for the lift, the two being lashed together

at the top and fitted with preventative spans on each, about 6 feet in, both being lifted together. The goose necks being 4 inches in diameter and extra strong, it was not deemed necessary to add any further support to them. The masts did not go through the deck, but were secured to it by heavy gusset plates, and, as the deck was supported by heavy through beams and longitudinals, no further support was added and did not prove necessary.

The purchases used were small mooring wire ropes, fastened to the derrick ends and acting as top block, and so on down to the winch barrel. We thought it better to try the gear, when fitting the shaft, and this we did and found it worked very satisfactorily. The propeller was now slung round the boss, the sling being well secured with small chain lashings, all terminating at the top or keyway side, so as to be easily undone when the propeller was fitted on to the shaft. In order to steady the derricks, when making the lift, four tackles were used as guys, two on each side, these being shifted at one time, as required. At a favorable moment the lift was made, and, when clear of the hatch combings, the derricks were guyed over a little and then the propeller was safely landed and secured on the starboard main deck.

The derricks were then guyed further over, a gin block was made fast to the center eyebolt under the counter, and another to the propeller, from which a wire rope tackle was led from the capstan aft, through the starboard fair lead, to a gin on the propeller, then to a gin under the counter, and the end made fast to the propeller. A large wire rope was then led from the forward capstan over the port bow, right along the whole length of the vessel's side, through the screw aperture and round the starboard quarter and made fast to the propeller boss. A similar wire rope was led from forward along the starboard side, and also made fast to the propeller boss.

Every precaution having now been taken to prevent the propeller from swinging and smashing in the ship's side, the propeller was lifted, and, at the first roll, it was allowed to slide over the ship's side into the water by lowering away the derrick tackles and starboard forward wire. At the same time the after capstan began to heave on its tackle, and the forward capstan on the forward port wire. This immediately brought the propeller well under the counter into a comparatively quiet position. Blocks and tackle having been hung from the eyebolt under the port counter were made fast to the propeller and secured. The lashings were then taken off the derricks, and after unhooking the port derrick tackle it was passed over the port counter, through the screw aperture, and made fast to the propeller once more.

Another lift was then made and the propeller was brought into position, blocks being hung from the starboard eyebolt and made fast to the boss. The propeller was thus held up and forward by the derrick tackles, up and aft by the tackle to the center eyebolt, up and against the body post by fore and aft wires and sideways by the tackles to the propeller lifting eyebolts.

We encountered considerable trouble in entering the shaft and key into the propeller boss, owing to the inclination of the shaft due to the trim of the vessel, and we only overcame this by taking off the weight now and again. We took the greatest care in handling the nut, lashing it securely and making it fast to the deck; the lashings were only removed when the nut had been screwed up three turns. To have lost the nut would have been just as great a disaster as losing the propeller.

After the "Monday" had been used vigorously for some time, and the propeller set hard up, the set pin was driven home and the most difficult work completed. The shafting we soon afterwards coupled up, replaced the bearings, warmed the engines through and started them very slowly. The voyage was once more resumed after the repairs had taken 8 days and 20 hours. When we consider the difficult nature of the work so successfully accomplished, and in so short a time, the lifting of a heavy mass of metal from the hold to the stern of a rolling ship, the fitting it on while at work on a plank 6 inches wide, one minute immersed five feet in the water, and the next minute 15 feet in the air, hanging on to a heavy hammer or key or nut, the loss of which meant failure to us and to the success of the whole undertaking, or when we consider the great risk of a sudden storm coming on when the loose propeller was hanging from the stern, the pluck, energy and ingenuity of the captain, the chief engineer and their respective staffs, will, I think, be appreciated by all in both professions. F. J. S. N.

Modification of Pump Plungers.

The following relates to changes in pump plungers as carried out in several ships of the United States navy by Chief Machinist E. Evans. The Blake pump is used to a large

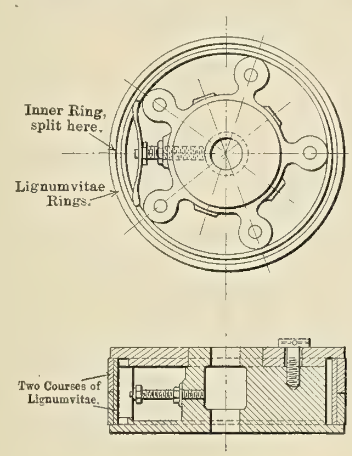


FIG. 1.

extent in the naval vessels and gives excellent service. The plungers of these pumps are constructed of composition, and are fitted with two outer rings of lignum vitæ and one inner ring of composition. The inner ring is split in one place only; the outer ring is pressed against the walls of the cylinder by adjusting bolts and springs (see Fig. 1). In time this

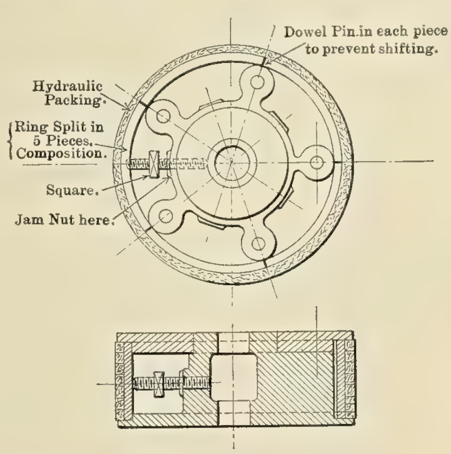


FIG. 2.

adjustment tends to wear the cylinder out of parallel, in consequence of which the piston, or plunger, allows the water to pass from one side to the other. Sometimes, due to long use and insufficient time for examination, this plunger carries away; oftentimes material for springs cannot be found, and

for the moment one is apt to have radical ideas as to the ultimate destination of the drawing office.

However, a simple, quick and efficient modification can be made by turning the lugs to a smaller diameter, then fitting a ring split in five pieces. The space between the rings and the walls of the cylinder are packed with hydraulic packing. This packing is set out by adjusting screws. This modification wears the cylinder evenly, and the hydraulic packing gives a fine, smooth, hard glaze to the cylinders.

ARTHUR A. SMITH,
Machinist, United States Navy.
U. S. S. *Charleston*, Chefoo, China.

Safety Appliances on Submarines.

Ever since submarines were first introduced, brainy men have been at work devising methods by which dangers to their crews can be reduced to a minimum. Those who are used to serving in these deadly little crafts will tell you that these dangers are not as great as is usually imagined, and that the loss of life from accidents has really been comparatively small.

The two great dangers are collision and explosion, and special attention has been given to methods that will prevent loss of life in case of accident from these two sources.

When the submarine is submerged, it is really half blind; for the periscope is only a makeshift eye. But even this has been greatly improved. Formerly the lens in use only allowed half the horizon to be examined unless the periscope was turned around. It could, therefore, happen that a ship might come up unnoticed and strike the submarine before it could dive into safety. It was in this manner that the British *A* 1 was sunk by the *Berwick Castle*. Now, however, a new lens has been devised which gives a complete view all around, so that an approaching vessel can be seen from whatever quarter it comes.

Another danger is escaping gasoline (petrol), which may lead to an explosion. By the regulations the engine must be stopped as soon as an escape is noticed; bad accidents being caused a few years ago by neglect of this precaution. In the early days of submarines, mice were kept on board, as they were affected by an escape of gasoline (petrol) long before the crew noticed it. They would run about, squeak violently, and show every sign of distress. But now the engines make so much noise that their squeaking would not be noticed. At present a more scientific method of detecting the escape of noxious fumes is in use. Two engineers employed at Portsmouth have invented an apparatus that registers the escape of gasoline (petrol) or other gases, coming into action long before sufficient can have escaped to form an explosive mixture. By an ingenious contrivance a red light is substituted for a white one and a bell is rung when there is a leakage of gas.

Sometimes sea-water will penetrate into the accumulators—a very serious danger, as chlorine is thereby evolved which may suffocate the crew. The *A* 4 had a very narrow escape in this way, but fortunately one of the attending ships was near and opened the hatch as soon as it was seen that something was wrong. Thanks to another invention, however, this deadly gas is now rendered comparatively harmless.

A safety helmet, somewhat resembling that worn in mine explosions, is now provided. Attached to a watertight canvas jacket that straps round the waist is a big helmet with a glass front, not unlike that of the ordinary diver. Just below the front of this is a magazine containing a special substance called "oxylithe," which has the power of giving off oxygen and absorbing the carbonic acid in the air when it comes in contact with water. In this manner the wearer of the helmet has always a good supply of air to breathe, so that in case of the evolution of chlorine the crew would hastily don these jackets.

The helmets have still another use; for, being full of air, they serve as life buoys. Thus, in the event of a submarine being struck by a passing ship and punctured, these jackets would be put on at once. Then the hatch could be opened and the men would float to the surface. However, if the hole were large, the water would pour in so quickly that there would be no time to get into these. But British inventive genius has not found this difficulty too great to solve, and now all submarines are being fitted with a very simple little safety device.

As soon as a submarine leaks, the water fills the bottom and pushes the air to the top, where a certain quantity is always held in any odd little corner near the ceiling. Therefore, thin steel partitions, depending a foot or two from the ceiling, in places where it slopes or forms corners, are being fitted in order to form air traps in different parts of the interior. Thus, when a bad leak occurs, quickly filling the submarine with water, the air is pressed into these traps. The crew immediately seize their helmets and stand with their head and shoulders above the water in the air traps, so that they can breathe while putting on the safety dress.

Another invention that has been tried in one or two of the underwater craft consists of a long flexible tube attached to the outside. At one end is a float, while the other communicates with the interior. In the event of an accident, this tube is liberated and is at once borne to the surface by the float, to which is attached a flare to give notice to any ship near at hand; until the submarine is raised, the crew can breathe through this tube, or food might even be passed down.

At least one American vessel is fitted with a door through which the crew can escape if necessary. This door opens into a chamber which, in its turn, communicates with an airlock. If it is desired to leave the submarine, a diving dress is donned and the airlock entered. The door communicating with the interior of the vessel is closed, and then the diver goes into the outer compartment, closing the door of the airlock after him. Water is then allowed to enter, and, when it is full, he merely opens the door and steps out. The door is then closed and the water pumped out again, so that others can follow.

ANDREW LEWIS.

Partial Collapse of After Engine.

The steamship *C*———— was on a voyage from Kobe, Japan, to London, via the Suez Canal; for fourteen days after we left Kobe everything was running smoothly and well, when suddenly, without any warning, the after engine collapsed. The first thing we did was to shut off steam and ascertain the damage. It was found, on examination, that the connecting rod, piston, cylinder and cover were broken, the tail rod was bent, and the lever bearing and front column smashed. The first thing to give way was the connecting rod foot, which broke right in two, while on the upward stroke, allowing the piston to come with a tremendous bang up against the cover, breaking piston and cover and cracking the cylinder. The parts then fell to about half-stroke, the broken connecting rod hanging well into the crank pit, the cranks again coming round caught the end of the rod, and forced it right through the column foot, thus bringing the engine to a dead stop.

The first thing we did was to disconnect the top end, and get down the bent and broken connecting rod, we then removed the low-pressure steam chest cover and disconnected

the valve from the spindle, shoring it in its middle position and then working her non-condensing by allowing the steam to flow from the high-pressure exhaust around the high-pressure to the low-pressure steam chest, and so into the atmosphere. After all this was done and a great deal of hard work accomplished, she was once more started under a fair head of steam, and then we worked the boilers down to 40 pounds of steam by the gage, which was all they could supply. After a run of four and a half days, a port was reached, where repairs could be effected.

On wiring home, an answer was received to the effect that a new cover, piston, piston rings and springs and connecting rod would be sent. Those in charge then started to patch the cylinder by means of a ½-inch steel patch, secured by ⅝-inch tapped bolts, having first drawn the cylinder to a level on the top edge by means of a strong plate.

On arrival of the new parts they were fitted up, and the vessel got under way, everything working well. After steaming for five and a half days, the self-same accident occurred again, this time wrecking the cylinder and piston rod as well as the parts mentioned before, except in this case the column was untouched, the connecting rod breaking in the middle of a very bad weld, that had been made in the rod, the clean iron showing on examination of the broken parts, only a small percentage of the entire welding surfaces. The broken parts were again disconnected and the engine got under way as before, with a run of eight days before her. The management of the boilers gave us great trouble during this run, as no blowing down could be done, owing to the bad state of the feed donkey. It took every effort to supply enough feed to the boilers to ensure steam, let alone any water for blowing down.

The boilers were worked as follows: When one showed very great density it was laid off and the other used for steaming, the laid-off one in the meantime cooling off; it was then blown down, run up again, fires were set away and steam got up to 70 to 80 pounds by the gage, then this boiler was put under way and the other treated in the same way, changing boilers about once in every thirty-six hours. Having reached port and moored, orders came to go further up the harbor; two tugs were engaged; the engines of the ship giving all the assistance that lay in their power. The tugs, however, from some misunderstanding, cast off the ropes and refused to take them up again. The chief engineer was then asked if he could work the engines to take the ship to her discharging berth among the other vessels. His reply being yes, the engines were then worked ahead and astern, according to the telegraph.

New parts having been again supplied and fitted, she proceeded on her next voyage without any further casualty.

F. J. S. N.

Fracture of High-Pressure Junk Ring and Bolts.

The steamship "A———" was on a voyage from London to Philadelphia, with about 5,000 tons of general cargo. Three days after leaving London, the exact time being 10 A. M., a slight bump was heard in the engines, followed at each revolution by a heavier one. The third engineer was on watch at the time, and, thinking something had come adrift about the pumps, ran round back of the engine to see if such was the case, but seeing nothing wrong there, and the noise continuing, he stopped the engines. On making a careful examination, all seemed to be in order, so she was slowly turned, and, as the high-pressure engine reached the top center, the bump was heard in that cylinder. The fire were partly drawn, safety valves eased, and then a message was sent on deck to let the captain know that the engines were temporarily disabled. We next put in the turning gear and then proceeded to lift the high-pressure cover; having taken the cover off, we found lying on the piston top two of the junk ring bolts, which were luckily in such a position that the bolt heads instead of coming against the cylinder cover and splitting it, had fallen directly under the escape valve opening, and fouled the body of the bolts only. There was a good clearance on the top, but the concussion had been heavy enough to split the junk ring in five places, and knock a piece out of it. We then stripped the piston and found that the bolts had broken at just the last thread in the nuts, and these being fitted in recesses in the side of the piston body were easily withdrawn and replaced by spare ones.

Four more bolts were found cracked in the same way and were renewed. It so happened that there was a spare junk ring on board, but it was 1½ inches too large, belonging to a cylinder which had been replaced by one of less diameter. This ring was reduced by chipping to a suitable diameter, the bolt holes were also cut out to suit the bolt centers, and the ring fitted in place of the broken one. We also drew out the check rings and refitted them, we then closed up the cylinder, took the turning gear out and set the engines going ahead slowly for a while. Full speed was soon resumed, and we completed the voyage without further mishap.

The primary cause of the breakdown was undoubtedly due to the floating ring having too much play, nearly 3/16 inch, instead of being only just able to move it. The secondary cause we found to be that at some previous time all the nuts had been renewed, but, at the same time, they had not been bedded on their seats, so that on screwing the bolts hard up the nuts did not bear all round, but on the corners only, thus bending the bolts to begin with, and enormously weakening them. We did not discover this until we reached port, and on examining the piston three of the new ones were found cracked as before. This led to all being refitted. The junk ring was also refitted and adjusted properly to the floating rings.

A Broken Crank Shaft.

The steamer "C——," when in the Indian Ocean, broke her crank shaft at the after end of No. 2 main bearing. A very stormy southwest monsoon was blowing, which made it very difficult to work, as the vessel was being put under all sail with the wind and sea abeam. However, the shaft was effectively repaired, and we afterwards steamed at a little under half speed against the storm to Point de Galle, a distance of 500 miles. Here we waited until the gale had gone down, and then proceeded slowly to Port Said; we stopped occasionally to lift the top brass to see if all was well, gradually increasing the speed as confidence was gained. On our way to Port Said we called at Aden, where we held a general examination, and during the latter part of the Red Sea passage and through the Suez Canal full speed was maintained. On our arrival at Port Said a new shaft was waiting for us.

The repair was made in the following manner: The fracture in the shaft was half in the web and half in the crank pin. Four holes one inch in diameter were drilled in the web, one at each side and two on the top corners. These holes were then tapped at 1⅛ inch and studs were made to suit. Then we made and fitted a steel band, but before this was finally put on, a dove-tail was cut into the crank pin and web, and a dove-tail was fitted to it, and was screwed in its place by two one-inch steel studs.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Practical Experiences of Marine Engineers.

During the past year we have devoted a few pages of each issue to articles contributed by men from the engine room, describing their experiences under various trying circumstances, such as are occasioned by breakdowns, mishaps and accidents of various kinds. The number and variety of interesting and valuable repair jobs which have thus been described have no doubt surprised many of our readers who, in the course of their sea-going experience, have had comparatively few difficulties of this nature to overcome. The ingenuity and resourcefulness displayed in making difficult repairs with inadequate tools and materials show that, although many of the dangers of the deep have been overcome, yet the same heroic spirit which characterized the old-time sailor in the performance of his dangerous calling still prevails in slightly different form below the grating of a modern steamship. Much of the spectacular and picturesque life of the sea has vanished, but in its place has grown up a profession which calls for the same courage and hardiness in overcoming difficulties. The forces with which the marine engineer has to deal in the engine room to-day are many times greater and more dangerous than those with which the old-time sailor battled above decks. That the many serious and minor breakdowns and mishaps which occur on steam vessels now result in neither loss of life nor injury to the passengers and crew, nor in irreparable damage to the vessel itself, speaks well for the efficiency of the marine engineer.

Although most of the articles which we have hitherto published under the head of practical experiences have dealt with breakdowns and repairs, yet we hope that the man who escapes these troubles and who keeps his vessel in smooth working order month after month will not consider it of too little interest to write and tell his friends how he accomplishes this result. Every engineer admires a smoothly running and efficiently operated plant on board ship, but the engines, boilers and auxiliaries of a steamship cannot be kept in such excellent condition without a continual exercise of knowledge and skill on the part of the engineer in charge. In maintaining an efficient, safe and reliable plant there are numberless topics worthy of discussion, and we hope that our readers will in future include such material in their contributions to the Department of Practical Experiences.

Motor-Driven Ships.

The announcement that the Hamburg-American Steamship Company is building a 9,000-ton vessel, to be propelled by Diesel engines, aggregating 3,000 horsepower, has occasioned much comment and speculation in the daily press, which would easily lead the uninformed to believe that this type of propulsion is to be extended immediately to the largest ocean liners and the latest *Dreadnoughts*. Press dispatches also intimate that the application of internal combustion engines to battleships will revolutionize warship construction and immediately render obsolete the most modern battleships and cruisers.

We have no hesitancy in calling such reports absurd; for the powering of a 27,000-ton battleship with internal combustion engines capable of driving the ship at a speed of 20 knots is to-day an impossibility. Until very recently, the largest marine internal combustion engine built was of 500 horsepower, and engines of that size were of the six-cylinder, double-acting type, so that considerably less than 100 horsepower was developed in each cylinder. The immediate development of the internal combustion engine into such sizes as would call for the production of a 1,000 horsepower in each cylinder is beyond the bounds of possibility in the present stage of the art of engine building.

The experiment of the Hamburg-American Steamship Company building two 1,500 horsepower Diesel engines to drive a 9,000-ton vessel at a speed of 12½ knots, will be watched with great interest, since the use of internal combustion engines for moderate-powered vessels has frequently been urged, provided the cost

of operation could be reduced to a reasonable figure. The fuel used in this case will be petroleum residue, which is the cheapest variety of fuel oil obtainable, and as the vessel is to be regularly engaged in transatlantic service, an adequate supply of fuel is insured at the terminals of the line.

With the question of an adequate supply of fuel at a reasonable cost disposed of, the adoption of this means of propulsion for this type of vessel offers a number of striking advantages. In the first place the steam-generating plant, with its enormous weight and troublesome up-keep, is done away with entirely. The bunker space is also cut down materially, so that there is a large saving in space, which can be used for cargo or passenger accommodations. Maintaining an efficient and intelligent fireroom force on a steamship is one of the greatest troubles with which a marine engineer has to deal; in the motor-driven ship this difficulty is entirely overcome, since only a small force is required in the engine room. The engine plant itself will, of course, be heavier than steam engines of the same power, but this added weight is but a small fraction of the weight gained through the elimination of the steam-generating plant. Moreover, the multiplication of units by the use of twin screws in a motor-driven vessel where a single screw would have been used in a steam-driven vessel of this size adds a factor of safety to the vessel, which is always gained by the use of multiple screws. It is doubtful whether anything will be gained in propeller efficiency, since the large, slow-speed single propeller of a cargo boat can be designed to have perhaps greater efficiency than almost any other type of screw. On the other hand, the use of twin screws permits placing the propellers in more advantageous positions relative to the stream line flow around the ship.

As to the relative economy of the steam and motor-driven ship, this is something which must be determined by tests after the installation is made. Without even approximate figures as to the cost of equipment, added cargo-carrying capacity of the motor-driven vessel over the steam-driven vessel, and the exact cost of fuel in the two cases, together with the actual economy of the oil engine, it is impossible to make even a fair guess as to the relative cost of operation in the two cases. Information regarding this point, however, will be awaited with much interest, and experience with a vessel of this size will give a valuable check on estimates which have previously been made for this type of propulsion.

As to the use of oil engines for warship propulsion, it is only necessary to recall the fact that warships must be able to operate in any part of the world and that they must be able to secure a supply of fuel at all ports. The supply and distribution of oil fuel is not yet adequate to warrant its use exclusively on war vessels, otherwise it would now be more generally used for fuel under the boilers. If internal combustion engines are to be adapted to warship use, it is more probable that it will be the gas engine using producer gas, although as yet the development of this type of propulsion is limited to such small powers that its use for warship propulsion is entirely out of the question. Even if oil engines or gas engines operating on producer gas could be applied to warships to-day, the claim that their use would revolutionize warship construction and render obsolete the most modern battleships and cruisers would be an absurd statement. The use of these engines would give some advantage in reduction of weight of the power plant which could be allotted to armor or armament, and the elimination of large smokestacks would enable the guns of a warship to be placed in more commanding positions. In reliability and speed, however, the motor-driven ship would very likely lose as compared with the turbine-driven ship, and after balancing up the advantages and disadvantages of the motor-driven warship it is difficult to see how it could possibly render obsolete the modern turbine-driven vessel.

Old Transatlantic Packet Ships.

Records of transatlantic travel before the days of steamships are somewhat incomplete. Fiction has dealt with this period to a certain extent, but accurate accounts of the vessels which were used at that time and of their performances and the general conditions of the service are difficult to find. Still more rare are engravings, prints or sketches of these old vessels, and it is only at the expense of much time and money that a collection of such pictures can be made. One of our contributors this month, who has made a careful search for this material for a good many years in out-of-the-way places, gives in brief form the history of the old transatlantic packet ships in whch the bulk of passenger and cargo trade was carried before the days of the steamship.

Brief as this article is, it mentions the more important companies which operated these packet lines, calls to mind the names of many of the well-known captains of the period, and describes with some detail the type of vessel employed in the service. Remarkable sailing records were made in those days, and in this as well as in many other matters pertaining to the general efficiency of the service credit must be given to the hardy American seamen and officers who manned the ships. By their indomitable courage and expert seamanship they were able to compete for many years with the rapidly-encroaching steamship. How the transatlantic steamship was developed and finally drove the sailing packet from the seas will be told by the same author in our next issue, and the article will be illustrated by many reproductions of rare prints and engravings.

Progress of Naval Vessels.

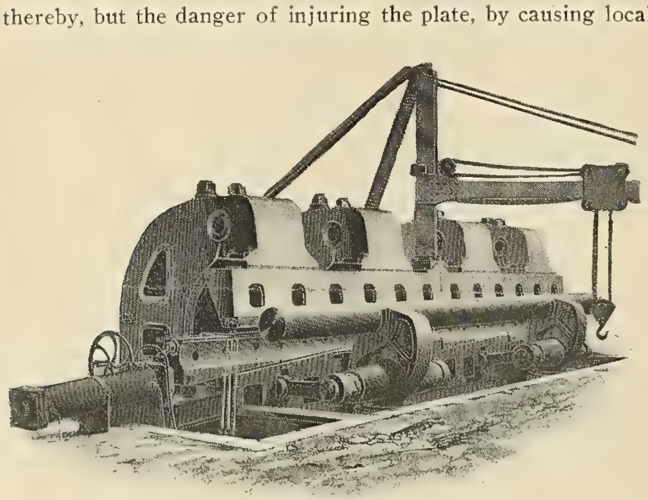
The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

	Tons.	Knots.		July 1.	Aug. 1.
BATTLESHIPS.					
Florida	20,000	20¾	Navy Yard, New York......	68.8	71.0
Utah	20,000	20¾	New York Shipbuilding Co...	80.0	83.2
Arkansas ...	26,000	20½	New York Shipbuilding Co...	34.6	39.5
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	28.4	32.3
TORPEDO-BOAT DESTROYERS.					
Paulding ...	742	29½	Bath Iron Works............	92.4	93.4
Drayton	742	29½	Bath Iron Works............	86.1	88.1
Roe	742	29½	Newp't News Shipbuilding Co.	92.3	97.1
Terry	742	29½	Newp't News Shipbuilding Co.	89.7	91.5
Perkins	742	29½	Fore River Shipbuilding Co...	86.8	92.3
Sterrett	742	29½	Fore River Shipbuilding Co...	83.8	88.4
McCall	742	29½	New York Shipbuilding Co...	85.4	89.6
Burrows	742	29½	New York Shipbuilding Co...	85.2	87.5
Warrington..	742	29½	Wm. Cramp & Sons.........	74.4	79.5
Mayrant	742	29½	Wm. Cramp & Sons.........	79.1	80.8
Monaghan ..	742	29½	New'pt News Shipbuilding Co.	26.7	28.4
Trippe	742	29½	Bath Iron Works............	49.9	56.7
Walke	742	29½	Fore River Shipbuilding Co...	39.1	47.6
Ammen	742	29½	New York Shipbuilding Co...	48.5	56.3
Patterson ...	742	29½	Wm. Cramp & Sons.........	33.0	40.7
SUBMARINE TORPEDO BOATS.					
Salmon	...	..	Fore River Shipbuilding Co...	97.4	97.8
Seal	...	..	Newp't News Shipbuilding Co.	51.2	52.2
Carp	...	..	Union Iron Works..........	58.6	60.0
Barracuda ..	...	..	Union Iron Works..........	58.6	60.0
Pickerel	...	..	The Moran Co..............	53.1	56.8
Skate	...	..	The Moran Co..............	53.1	56.8
Skipjack	...	..	Fore River Shipbuilding Co...	45.3	48.6
Sturgeon ...	...	..	Fore River Shipbuilding Co...	43.7	46.2
Tuna	...	..	Newp't News Shipbuilding Co.	28.3	29.9
Thrasher ...	...	..	Wm. Cramp & Sons.........	6.4	7.9

ENGINEERING SPECIALTIES.

Patent Hydraulic Keel=Plate Bending Machine.

This machine has been designed for bending steel plates, cold, for ships' keels, for doing all kinds of straight flanging for floor plates, bulkheads, intercostals, deck houses, tanks and other ship work, effecting a great saving both in weight of material and riveting. With this machine it is not necessary to heat the steel plates, and not only is a great saving effected thereby, but the danger of injuring the plate, by causing local



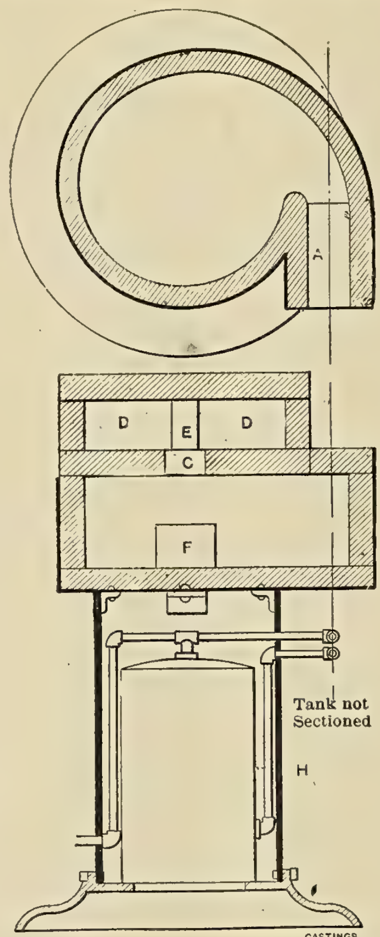
strains, due to unequal heating, is obviated. The plate also comes from the machine with the flange set perfectly straight and fair, and the body of the plate free from buckles or marks of any kind. The speed with which the work is accomplished is a special feature, as it is claimed that each plate is gripped and flanged in three or four minutes.

The plate is held fast in the machine by sliding wedges actuated by a horizontal cylinder and ram. The bending or flanging of the plate is accomplished by a roller of best forged steel, actuated by two large vertical oscillating cylinders. The roller is adjustable in and out for bending light and heavy plates, having steel links and screws worked by steel nuts, worm wheels, worms and large hand wheels. With this arrangement of links and screws the roller is adjusted, and the bending moment for light and heavy plates is the same throughout the operation of bending, *i. e.*, the roller follows the plate at an equal distance from the bending point throughout the process of bending. The beam against which the plate is bent is made of best "Siemens" cast steel, and is arranged so that double flanges for flat-bottomed vessels may be bent. A keel plate may be bent to any desired strake or twist the same as in an ordinary hand-geared machine for bending keel plates.

The machine is supplied with the necessary valves and pipes connecting valves to cylinders; it is made in various sizes to bend keel plates cold from ¾ inch to 1⅛ inches thick, and from 16 feet up to 31 feet 6 inches long. It is manufactured by Hugo Smith & Company, Possil Engine Works, Glasgow.

Monarch Rivet=Heating Furnace.

The Monarch Engineering & Manufacturing Company, Baltimore, Md., have on the market a portable rivet-heating furnace which is especially recommended for ship, bridge, boiler and general construction work. Oil or gas is used as the fuel, and, referring to the illustration, the flame is di-

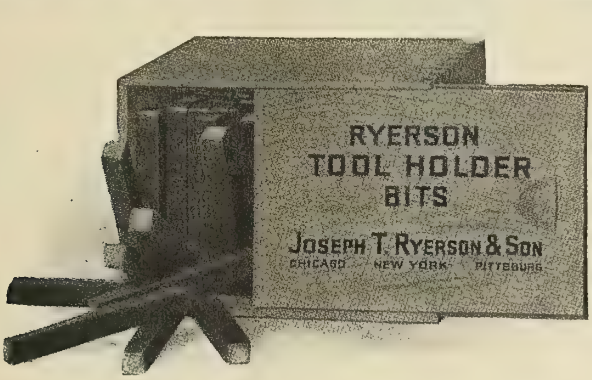


rected into combustion chamber *A*, where the oil is thoroughly ignited. It then passes into the heating chamber *B*, the construction of which gives the flame its rotary motion, distributing the heat uniformly throughout the whole interior. The waste heat escapes through the opening *C*, and distributes itself into the open chamber *D*, where the rivets may be placed prior to their being put into the heating chamber *B*. The fur-

nace is supported on a steel cylindrical sheet, which contains the fuel oil tank *I*, and the whole is mounted on a cast iron base. The furnace top is made of steel, securely welded together, with angles riveted to the bottom, so that the furnace top may be set on to the sheet without being permanently attached to it. It is claimed that the furnace carries a high, soft, uniform heat, and is always under control of the operator, the rivets always being in plain sight and readily reached. The capacity of the furnace is claimed to be 3,000 ¾-inch rivets per day, and from 1½ to 2 gallons of oil are consumed per hour, according to the quantity of rivets heated.

Ryerson Tool Holder Bits.

Joseph T. Ryerson & Son, Chicago, Ill., are now putting on the market Ryerson tool holder bits, which are made of high-speed steel already hardened in tool holder sizes, cut in 3-inch lengths and packed in small boxes. The only work necessary



is to grind to shape. This will meet with great favor among small shops, as it means considerable saving in material and time, and owing to the excellent facilities which the manufacturers have for hardening, best results are obtained from the high-speed tool steel.

An Automatic Low-Pressure Acetylene Gas Buoy.

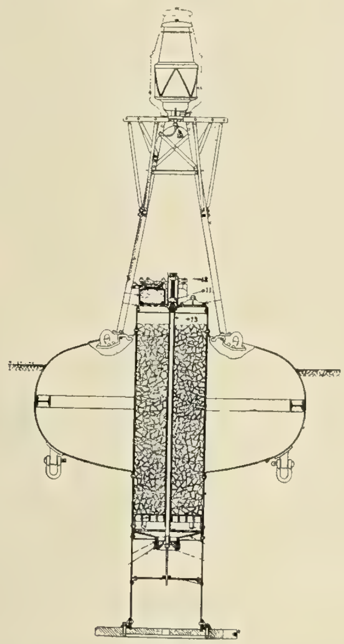
Until recently floating lighted buoys were generally operated by high-pressure oil gas. This gas was generated on shore and compressed to a high-pressure and stored in heavy steel holders. These holders then had to be transported to the buoys and the gas transferred, involving considerable time and expense when it became necessary to recharge the buoys.

Recently a new system of supplying gas for lighted buoys has been developed by the International Marine Signal Company, Ltd., Ottawa, Can. Under this system the lighting medium is low-pressure acetylene gas from which all impurities have been removed by the use of a special purifier. The buoys are charged with from 1,500 to 3,500 pounds of calcium carbide, which, it is claimed, gives a continuous light without diminution of power for from six to nine months, during which time the buoy requires no attention. The lantern used is the best buoy type, equipped with a Fresnel lens, which condenses the light into an intensely powerful and penetrating horizontal beam. This, coupled with the fact that acetylene gives a brilliant penetrating light of high-candle power, makes the light especially valuable for marine work.

These buoys are manufactured in various sizes and shapes to meet special requirements, but the operating parts of all the buoys are practically similar in each case to those shown in the diagram. The buoy consists of a gas generator tube of steel, supported by a steel floating chamber; a lantern support, made of steel, which is attached to the deck of the floating chamber; a lantern; a purifier chamber located at the top of the generator, and the counterweight attached to the bottom of the generator tube to give the buoy the necessary stability.

The generator has a diaphragm a few feet from the bottom of the tube; the center of this diaphragm is fitted with a conically-seated valve mounted on a valve stem, which passes up through the center of the generator and through the generator head. The upper end of this valve stem is fitted with a hexagon nut just above the generator head; the part of the stem passing through the generator head has a keyway cut into it, and a spline is fitted into the generator head engaging the keyway, so that when the nut is turned to close or open the valve the stem cannot turn, it can only move up and down. A stop collar is attached to the extreme top end of the valve stem, with the object of preventing the nut from being turned so far as to drop the valve and valve stem.

To prevent leakage of gas when the buoy is in operation, a cap is screwed down upon the generator head against rubber packing. This cap is long enough to permit the valve stem being raised or lowered, so that the valve may be adjusted to give an opening suitable for the conditions under which the buoy may be working. The valve stem is inclosed within



a guard pipe to protect it from the carbide, and it works through a guide bar, which is bolted to shelf angles at the side of the generator tube. In the center of the diaphragm and surrounding the valve is fitted a grid, which prevents small pieces of carbide which may pass through the grate from falling into the water and wasting their gas. This grid acts as a valve seat and is provided with a rubber packing, which is held in a groove in the seat and projects sufficiently to make a good joint with the valve when it is closed, even if it be foul. A steel grate upon which the carbide rests is attached to the inside of the generator a short distance above the diaphragm.

In operation the generator is filled with calcium carbide in large crystals 8 inches by 4 inches, and the buoy is placed in the water with the valve open and the valve cap screwed down. The water enters the generator through the hole shown in the center of the counterweight at the bottom of the tube, and passes through the valve up to the carbide resting on the grate. The contact of the water with the carbide immediately produces gas, which passes up through the carbide and into the purifier chamber, where all impurities and

dust are removed; thence it proceeds through a small valve and pipe to the lantern.

When gas is produced faster than it is consumed by the lantern it accumulates in the generator at an increasing pressure, that gradually forces the water away from the carbide, thus stopping generation. As the surplus of gas is consumed by the lantern the gas pressure gradually decreases, thus permitting the water to come in contact with the carbide when generation is resumed. In this manner the buoy is absolutely automatic in operation, and the pressure can never rise above that corresponding to the head of water, due to the denpth of the generator tube below the surface. This pressure is about 6 pounds per square inch. It is practically impossible, therefore, for disastrous explosions to occur such as have frequently taken place where buoys are charged with high-pressure gases or compressed acetylene.

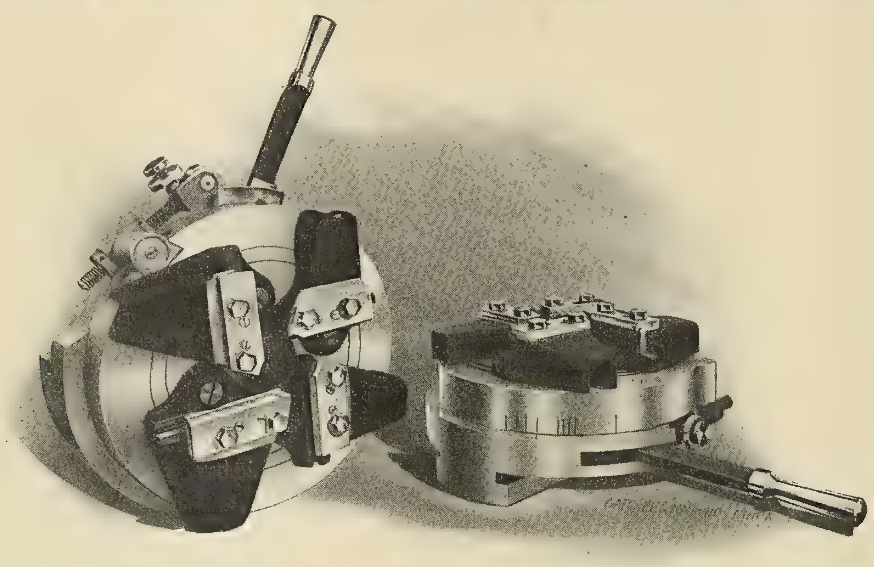
The purifying chamber which cleanses the gas is filled with a special chemical mixture, which it is claimed will absolutely prevent carbonization or clogging of the burners. As has been stated, these buoys will remain in continuous operation from six to nine months, when they can be recharged with calcium carbide, which can readily be purchased in almost any market. The purifying agent, it is claimed, will last about a year.

Stationary Die Head for Pipe Threading.

A stationary die head for pipe threading is being manufactured by the Landis Machine Company, Waynesboro, Pa., in which the Landis type of die is used with a manually-operated die head. This head is made especially for use on pipe-threading machines, wherein the pipe revolves and the head remains stationary, the dies being opened and closed by hand.

Special holders are made for pipe threading where it is not necessary to cut very close to a shoulder. The clamp with which this chaser is held is what is known as a mill clamp, which besides holding the chaser rigidly protects the chaser in case the pipe splits. The clamp comes down over the throat of the die, and is rounded out near the cutting point, so as to act as a guide for rough ends, and at the same time

when a twister occurs in the pipe the strain is thrown in great part on the clamp, thus protecting the die in such manner that the liability of breakage is very small. In case of threading close to a shoulder a clamp is used which comes flush with the front edge of the chaser only, thus permitting the die to run close up against the shoulder as in threading short nipples, etc. It is claimed that these dies admit of cutting speeds from 25 to 100 percent higher than the hobbed type of



The head is made entirely of steel as are also the die holders. The chasers for the heads can be made to good advantage from high-speed steel, as it is claimed that they never require to be annealed, rehobbed or retempered, and that they have the further advantage of long life. The sharpening of the die is a simple operation, and is taken care of by grinding on the ends of the chasers and again setting them to the correct cutting position in the holders by means of a small gage furnished with the die head. The heads are made in standard sizes to take work up to and including 4 inches. One set of dies will cut all the diameters coming within the same pitch. As there is but one pitch covering the sizes from 1 inch to 2 inches, inclusive, one set of dies covers this range. The same is true on the other pitches.

die, and that the rake can at all times be ground to suit the quality of the material in the pipe to be threaded.

The heads are graduated for setting the dies to the different diameters to be threaded. The head is opened and closed by hand, and when in the closed position the die is rigidly locked, but opens and closes freely by means of the lever. All dies are made to interchange, and if one chaser of a set should be worn out in advance of the others this single chaser can be replaced without replacing the entire set. Dies of any one pitch will interchange on any of the die heads so long as the pitch is within the range of the head.

The heads are made in standard sizes as follows: From ¼ to 1 inch, inclusive; from ¼ to 1½ inches, inclusive; from ½ to 2 inches, inclusive; from 1 to 4 inches, inclusive.

TECHNICAL PUBLICATIONS.

Hydraulic Elevators. By William Baxter, Jr. Size, 6 by 9 inches. Pages, 326. Figures, 260. New York, 1910: McGraw-Hill Book Company. Price, $2.50 net.

The design, construction, operation, care and management of various types of hydraulic elevators are carefully considered in a practical manner in this book. A large number of diagrams and illustrations serve to give the reader a comprehensive idea of the details of elevator construction and operation. It will be found particularly valuable as a work of reference for the engineer who has not specialized in such work, but who is sometimes confronted with problems requiring accurate knowledge of many of the details.

Manual of Steam Engineering. By W. H. Wakeman. Size, 3 by 5½ inches. Pages, 441. Numerous illustrations. New York, 1910: New York Belting & Packing Company, Ltd.

This book is primarily a reference book, containing data used in every-day engineering practice, arranged in convenient form, with sufficient explanation to render the matter both interesting and instructive. It contains many tables, which are arranged for use in connection with the reading matter on the same subject, thus condensing information into convenient space and rendering it available for busy workers. The author has had considerable experience as a technical writer, and this has enabled him to present the various subjects treated in an exceptionally clear and useful manner. The book is divided into two parts, one of which is confined to steam boilers and the other to steam engines.

Beeson's Marine Directory of the Northwestern Lakes. Size, 6¾ by 9½ inches. Pages, 273. Numerous illustrations. Chicago, 1910: Harvey G. Beeson. Price, $5.

This is the twenty-fourth year of publication of this directory, which is now recognized as a standard authority on commerce and shipping on the Great Lakes. It includes tables of American and Canadian steam and sailing vessels on the Great Lakes, information regarding vessels which have been lost during the previous season, the various transportation and shipping associations, classified lists of vessels according to the trade in which they are engaged, particulars of the engines and boilers of the vessels, as well as interesting articles regarding various Lake ports and miscellaneous marine subjects. The numerous half-tone illustrations are also of considerable interest.

American Producer Gas Practice and Industrial Gas Engineering. By Nisbet Latta. Size, 7½ inches by 10½ inches. Pages, 539. Illustrations, 247. New York, 1910: D. Van Nostrand Company. Price, $6 net.

This is by far the most complete work which has yet appeared on American producer-gas practice. That this branch of engineering has already reached immense proportions will undoubtedly surprise many to whom the subject of producer gas has been placed in the category of new developments. Not only for power apparatus but for a great number of varied industrial purposes has the gas producer now become an essential piece of apparatus. Any handbook, therefore, which attempts to cover the field completely soon reaches large proportions. Undoubtedly this book might have been made more concise; but at the same time the value of the data and careful treatment of each subject make it worth a careful study. The author states in the preface that the book was originally written with the urgent desire to maintain an impartial attitude, and to narrate as accurately as possible, without prejudice or undue influence, the various features of gas engineering at present in vogue in the industrial field. This naturally involves the description of a great many patented systems and pieces of apparatus, and where this has been done the description is placed before the reader, together with the method of operation or other data for the purposes of giving information and drawing comparisons, leaving the reader to draw his own conclusions as to the value of the apparatus.

The early chapters of the book include producer operation; cleaning the gas; works details; producer types; moving gases; solid fuels; physical and chemical properties of gases and gas power. The subject of gas engines is treated briefly and from a general standpoint. The remainder of the book is taken up with a discussion of various industrial gas applications and a discussion of heat, combustion, furnaces, pipes, flues, chimneys, etc. The final chapter contains useful tables for use in gas engineering practice, while in an appendix oil fuel producer gas is briefly considered. As this is a more recent development the amount of data available is, of course, limited. This is a direction, however, in which it is very likely that considerable development will take place in the near future, and, therefore, any data appearing upon the subject from reliable sources is of considerable value and cannot be overlooked.

The Engineering Index Annual for 1909. Size, 6½ by 9¼ inches. Pages, 471. New York and London, 1910: *The Engineering Magazine.* Price, $2.

This book represents a continuation of that originally started by the late Prof. J. B. Johnson in the *Journal* of the Association of Engineering Societies in 1884, and turned over by that association to *The Engineering Magazine* at the close of 1895. Each year it has covered with increasing thoroughness the field of periodical literature in engineering and closely related applied sciences. This volume, which is the fourth since the publication has assumed the annual form, comprises a classified index to all engineering literature during the year. The classified plan of indexing, which has only recently been followed out, serves to combine for each specialist a list of the entire current literature on his subject, and to assemble it in such small space that it may be readily found and completely explored. The value of this work is obvious, and it is sufficient to say that the present volume has been edited with the same care and thoroughness as previous volumes, and that it has been made even more comprehensive.

The Yachting Manual and Marine Motorists' Handbook. Size, 4 by 6½ inches. Pages, 306. Numerous illustrations. London, 1910: Horace Cox. Price, 1s.

This book is a comprehensive compendium of valuable information for yachtsmen and motor boat owners, carefully edited and condensed into a pocket edition. Information is given regarding such subjects as the tides, signals, first aid to the injured, general seamanship, Lloyd's classifications, local sailing directions, a glossary of nautical and technical terms in English and French, tables of weights and measures, foreign currencies, records of interest to yachtsmen, rating rules, charts of the various race courses, as well as a list of the racing fixtures for 1910.

PERSONAL.

A. D. GILLETT, for many years a well-known builder of steamboats in the Mississippi Valley, died recently at Lake City, Minn.

EDWIN B. SADTLER has been appointed New York representative of the New York Shipbuilding Company, Camden, N. J., with headquarters at 12 Broadway, New York City.

NAVAL CONSTRUCTOR J. H. LINNARD, U. S. N., who has been on duty at the Bureau of Construction and Repair since March, 1901, has applied for and been granted a transfer to the retired list. Naval Constructor Linnard is the senior officer of the Naval Construction Corps in the United States navy. His long and meritorius service has won for him the unqualified approbation of his superior officers, and his retirement from active duty will be greatly regretted by all those with whom he has had official dealings, both in civil and naval circles.

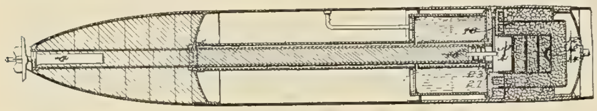
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

956,813. APPARATUS FOR PRODUCING A MOTOR FLUID. HUDSON MAXIM, OF BROOKLYN, N. Y.

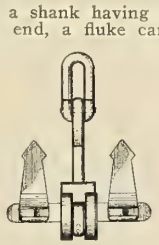
Claim 4.—In an apparatus for producing a motor fluid, the combination of a closed combustion chamber containing a self-combustible material, a spraying or atomizing device leading into said chamber, a



reservoir connected with said device and containing liquid, and a movable wall to said reservoir having a greater area exposed to the products of combustion than is exposed to the liquid in the reservoir. Eighteen claims.

957,830. ANCHOR. JAMES EDGAR WILDE, OF CHESTER, PA.

Claim 1.—In an anchor, a shank having a cross head and provided with a recess at its lower end, a fluke carrying shaft engaging said



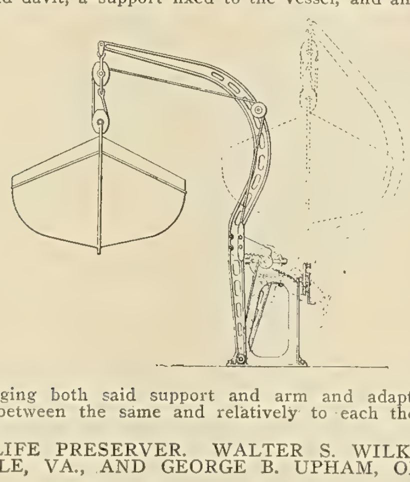
recess, a bearing block seated in the recess, and disks upon the fluke carrying shaft having notches engaging the cross head of the shank. Three claims.

958,650. ATTACHMENT FOR TORPEDO TUBES. JULIUS KIMBRELL, OF NEEDLES, CAL.

Claim 1.—A torpedo tube, a rear door for the same having a locking dial provided with a rack segment, motor-driven means for closing the door, motor-driven means for locking the door, including a pinion engaging the rack segment and a driven shaft with which said pinion is detachably connected, and means for timing the starting of the motors whereby the closing and the locking are effected. Five claims.

958,340. DAVIT FOR HOISTING AND LOWERING BOATS. AXEL WELIN, OF LONDON, ENGLAND, ASSIGNOR TO WELIN DAVIT AND LANE & DE GROOT COMPANY, CONSOLIDATED.

Claim 1.—The combination of a davit pivoted to swing, an arm carried by said davit, a support fixed to the vessel, and an intermediate



member engaging both said support and arm and adapted to travel transversely between the same and relatively to each thereof. Eight claims.

960,129. LIFE PRESERVER. WALTER S. WILKINSON, OF WYTHEVILLE, VA., AND GEORGE B. UPHAM, OF BOSTON, MASS.

Claim 1.—As an article of manufacture, a filler for life preservers comprising blocks composed of granules or small bodies of buoyant material, a waterproof fabric covering therefor, and an outer covering of buoyant material. Seventeen claims.

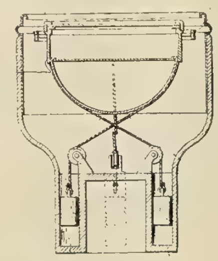
961,285. REVERSIBLE PROPELLER. ELLSWORTH S. BRYANT, OF DETROIT, MICH.

Claim 2.—A reversible-blade propeller mechanism comprising a rotatable main shaft, a solid hub secured thereto having bearing facets in planes parallel to the shaft axis, a propeller blade pivotally secured on each facet to swing obliquely to the shaft, a coupler adapted to swing the blades in unison, a sleeve non-rotatably and longitudinally reciprocable on the shaft and carrying the coupler, a bushing rotatably secured on the sleeve, a standard having a boss in screw-threaded engagement with the bushing, a gear on the bushing, and a lever swinging on the standard transverse to the shaft provided with a rack in mesh with the gear. Five claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

2,277. MAGNETIC COMPASSES. J. C. DOBBIE, GLASGOW.

Claim.—The invention has for its object to cause oscillations of the bowl to be rapidly damped down. In the plane of the knife edges are attached a pair of cords passing over pulleys mounted on the binnacle, the cords carrying weights. A second pair of weights may be pro-



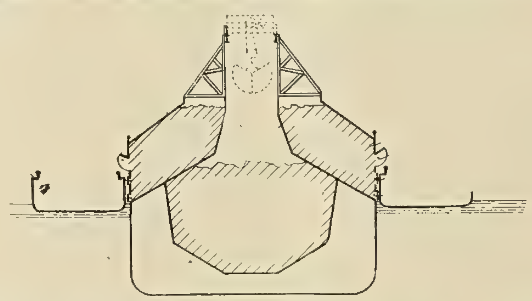
vided at right angles. By the above construction the tendency of the compass bowl to oscillate and give rise to disturbances of the card is greatly diminished by the friction introduced by the cords and pulleys and partly by the inertia of the weights.

3,630. DOCK AND METHOD OF DOCKING SHIPS. N. GROUCHETZKY, ST. PETERSBURG, RUSSIA.

Claim.—In order to accommodate ships of greater depth than heretofore, the keel blocks form a chain which can be drawn from its position below the keel on to the side wall by gearing. The ship can then be floated in and the gate closed. Water is next forced pumped in and the ship then raised so that the keel blocks can be hauled back to their place, then the water is let out in order that the keel may rest upon them.

7,358. SELF-DISCHARGING SHIPS. H. GATJENS, HAMBURG, GERMANY.

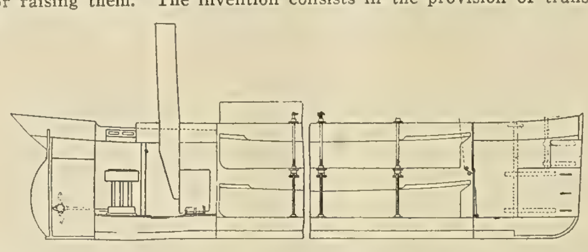
Claim.—By this arrangement the decks are sloping and several apertures or rows of apertures are vertically provided between the separate decks, so that on the ship automatically rising in consequence of the discharge of the cargo, the separate rows of apertures can be brought



successively into use. If the ship is of sufficient beam, the cargo may all be so stowed that it will thus discharge itself. With ships of smaller beam it is advisable to stow most of the cargo between the decks, arranged for self-discharging, and to place the remainder beneath these decks and raise it by grabs or otherwise.

20,756. SHIPS FOR CARRYING SMALLER VESSELS. A. N. DEN OUDEN, BOLNES, HOLLAND.

Relates to vessels adapted to be sunk so as to admit torpedo craft, etc., for raising them. The invention consists in the provision of transverse



bearers adapted to receive a small craft and to be moved upwards, providing sufficient space for another craft beneath. Rotatable doors are arranged externally and adjacent to the ordinary trap doors.

17,289. SHIPS' STEERING GEAR BRAKES. M. DRYSDALE, GRAVESEND.

The brake, in accordance with this invention, comprises a strap passing around a brake drum on the steering wheel, the ends of the strap being connected with a double-action foot lever consisting of two lever members extending in line and connected by toothed sectors so as to move in unison. A rod is connected to one of the lever members, and is furnished at its upper end with ratchet teeth adapted to engage with a front plate so as to hold the brake at any desired tension.

28,439. FITTING SHIFTING BOARDS IN HOLDS, IN WAY OF HATCHWAYS. F. W. BARDENS, LONDON.

According to the invention, a vertical girder is constructed to form two vertical channels on opposite sides. The girder is erected in the center of the hatchway, one of the channels at the fore and the other at the after side. The lower end is secured to shoes at the bottom of the hold. The top is secured to a thwartship beam at the middle of the hatchway coaming. At the fore and after ends of the hatchway vertical channels hold the two separate sections of boards in position.

International Marine Engineering

OCTOBER, 1910.

NEW AMERICAN-HAWIIAN STEAMERS.

The three steamers, *Kentuckian, Georgian* and *Honolulan,* recently constructed by the Maryland Steel Company, Sparrow's Point, Md., for the American-Hawaiian Steamship Company, of New York, are of the best type of American merchant cargo vesels. The vessels and fittings are built to the highest requirements and classed X-100 A-1 Lloyds. They are two-masted, forward and aft, schooner-rigged, with accommodations for crew and twenty-four passengers on the *Kentuckian* and *Gecrgian* and forty-eight passengers on the *Honolulan.*

DECK SCENE ON ONE OF THE NEW AMERICAN-HAWAIIAN STEAMERS, SHOWING AMPLE FACILITIES FOR HANDLING CARGO.

The general dimensions are as follows:

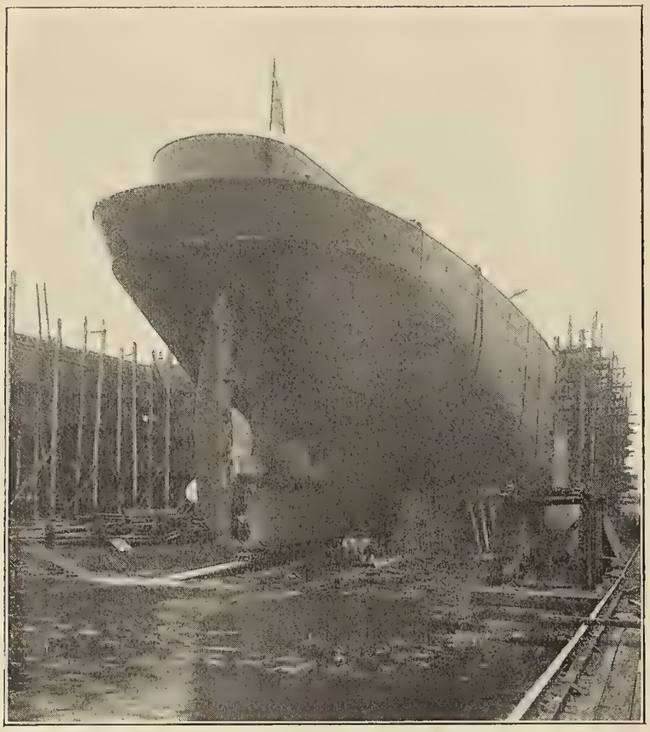
Length over all......................	429 feet 2 inches.
Length between perpendiculars.........	414 feet 2 inches.
Breadth, molded	53 feet 6 inches.
Depth, molded, to shelter deck.........	39 feet.

All have straight stems, elliptical sterns with three steel decks extending all fore and aft, fore and aft peaks, and forward and after deep tanks. Double-bottom tanks, 1, 2, 5 and 6, are constructed for carrying either fuel oil or water ballast. Double-bottom tanks, 3 and 4, under the engine room and fire room are fitted to carry fresh water. There are seven watertight bulkheads, all extending to the upper deck and the after peak extending to the shelter deck.

In the afterhold a complete oil-tight deck is laid at the top of the shaft tunnel, forming an after deep tank alongside the tunnel. The deep tank forward of the fire rom is fitted up for either cargo, oil or water ballast.

A cofferdam, one frame space in length, is fitted between this deep tank and the fire room. There are five hatches through each deck, and hatches to the deep tanks extending to the upper deck.

The accommodations for the crew, officers and passengers are in steel deck houses above the shelter deck and in the after upper 'tween decks. The refrigerator room is located on the upper deck immediately aft of the engine room.



STERN VIEW OF THE GEORGIAN BEFORE LAUNCHING.

The rooms for passengers are fitted with two pipe frame berths and pipe frame seats with spring mattresses, the seats being used for a berth. A folding lavatory is fitted in each room. The toilet arrangements are ample and of the very best quality.

The dining saloon for officers and passengers is located in the forward end of the shelter deck-house, and is finished with quartered oak, with the ceiling paneled and finished in white enamel.

The floors of the officers' and crew's quarters and passengers' rooms are covered with Asbestolith. The toilet rooms are tiled and fitted with enameled iron fittings.

Each vessel is fitted with a steam windlass, steam winches, steam capstan and Brown Bros'. steam tiller and auxiliary tiller, with engine actuated by a telemotor from the steering house, pilot house and flying bridge. These were all furnished by Hyde Windlass Company, Bath, Me.

The two steel masts and four derrick masts are fitted with booms for handling the cargo. There are in all twenty-one booms, all of 5 tons capacity, with the exception of one on after side of the foremast, which is of 30 tons capacity. There are three cargo ports on each side of the upper and shelter decks, also a small port in the coal bunker for carrying case goods in the bunkers while ship is burning oil.

These vessels carry 8,600 tons deadweight on 27 feet mean draft, and maintain a sea speed of 11 knots loaded. They are all fitted with wireless, and all holds are ceiled and have sparring fitted. Special freight rooms are fitted in the lower 'tween decks for bonded freight.

The *Honolulan* has a social hall and smoking room for the passengers. The social hall is finished in old ivory and the smoking room and dining room in selected quartered oak. The main entrance hall will have rubber tiling on the floor, and the other public rooms will have Asbestolith. The toilets are fitted with solid porcelain fixtures, all pipes nickel plated. The sides and floors of the toilets are tiled. The passengers' rooms are fitted with General Electric portable electric heaters.

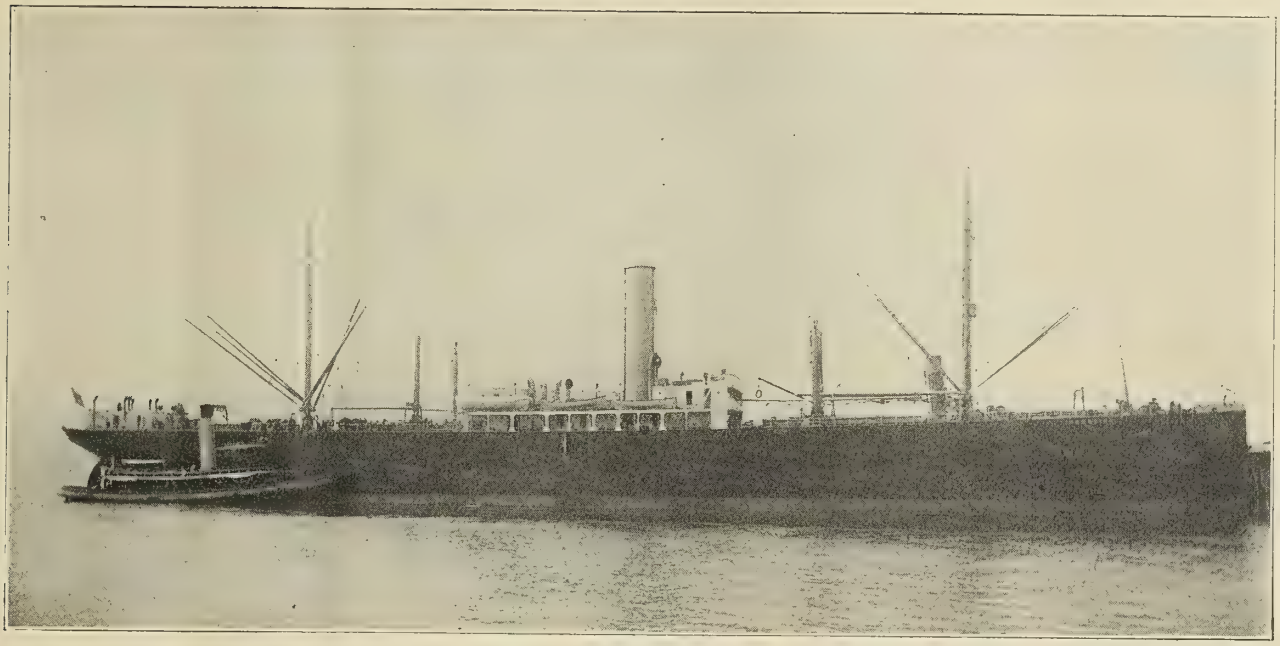
The *Kentuckian* and *Georgian* will run between Porto Mexico and New York, and the *Honolulan* between San Francisco and Honolulu. The *Honolulan* is fitted with Welin quadrant davits.

All three ships are of the single-screw type, and are driven by quadruple-expansion engines of the vertical inverted, direct-acting, surface-condensing type. All the machinery was built and classed 100 A-1 Lloyds.

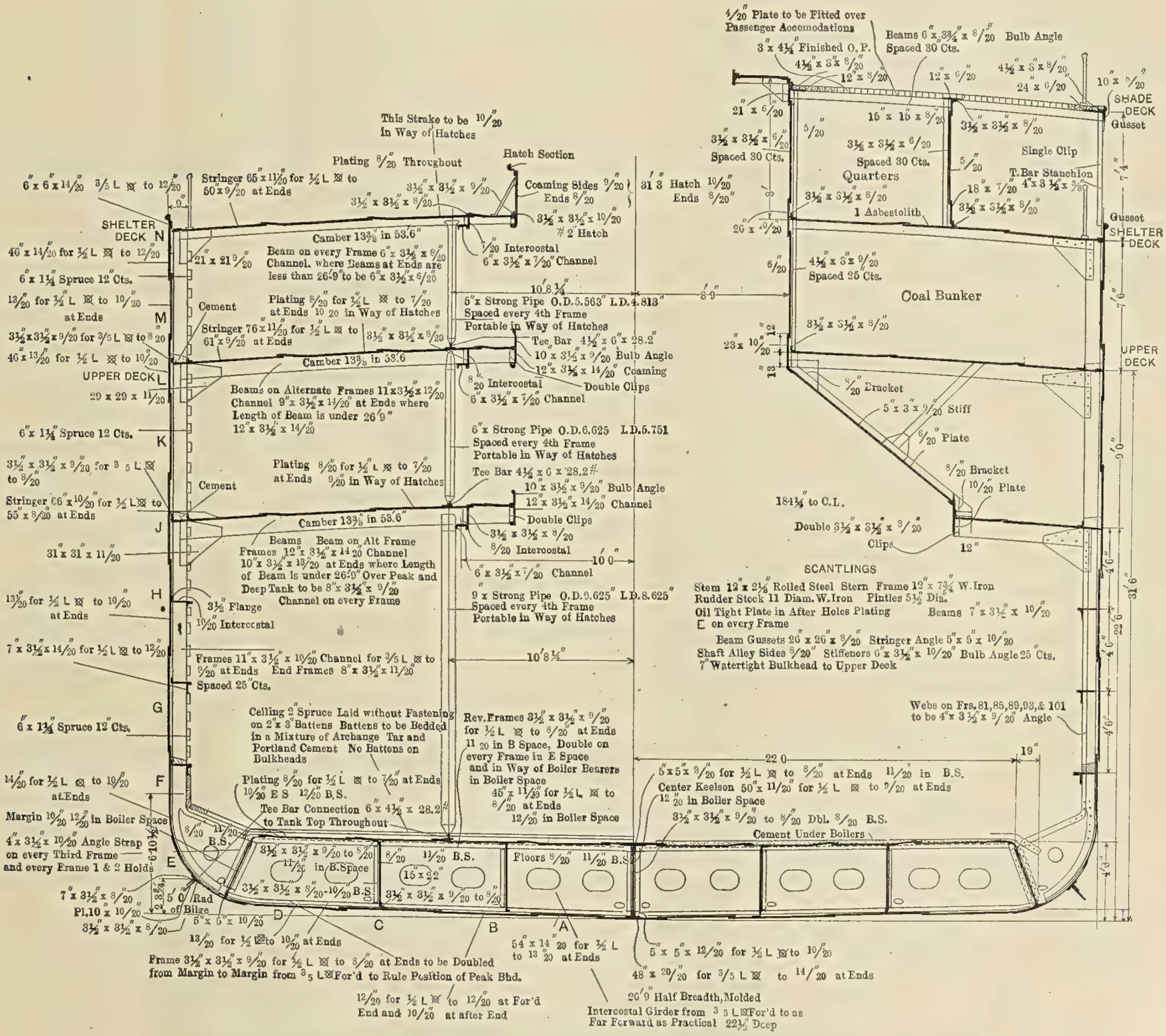
The cylinders are, respectively, 25 inches, 36 inches, 52 inches and 76 inches diameter by 54 inches stroke. The high and first intermediate are each fitted with one piston valve, and the second intermediate and low-pressure are each fitted with two piston valves. The valve gear is of the Stephenson double-bar link type, and is provided with a direct-acting reversing engine. The pistons, cylinder covers and valve chest covers are of cast iron. The engine is fitted with an operating gear, reversing engine and throttle, which is all controlled from the working platform.

HULL OF ONE OF THE NEW AMERICAN-HAWAIIAN STEAMERS IN FRAME AND NEARLY PLATED.

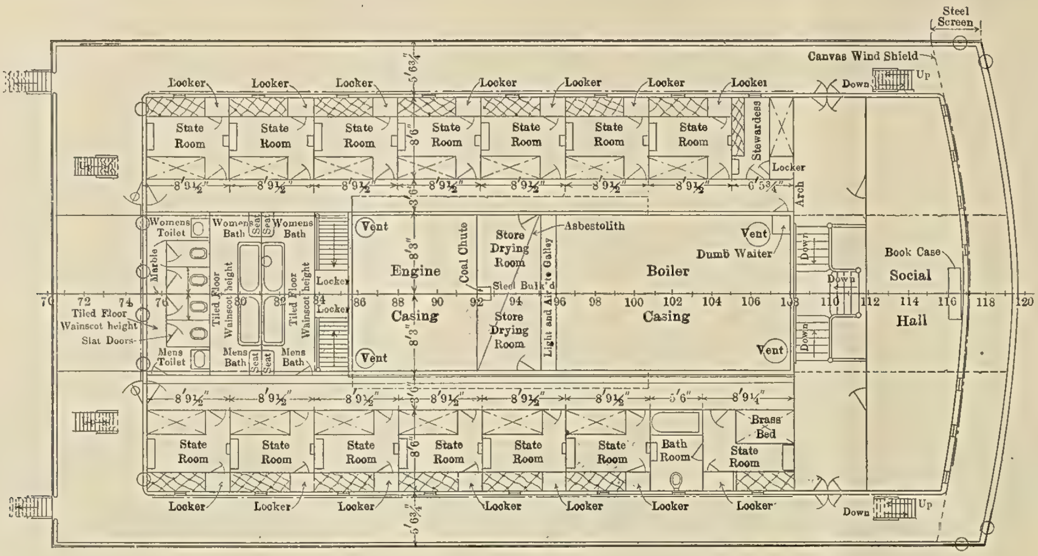
The bedplate and columns are cast iron of the box type. The crankshaft is built up in four interchangeable sections, with solid couplings forged on the shaft. The turning gear is located on the coupling at the aften end of the engine. The thrust block is fitted with cast steel horseshoe thrust collars.



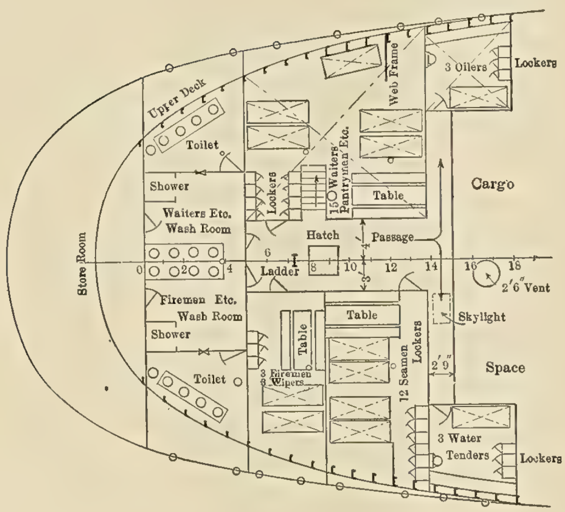
THE GEORGIAN.



MIDSHIP SECTION OF THE NEW AMERICAN-HAWAIIAN STEAMERS, SHOWING PRINCIPAL SCANTLINGS.



SHADE DECK PLAN OF THE HONOLULAN.



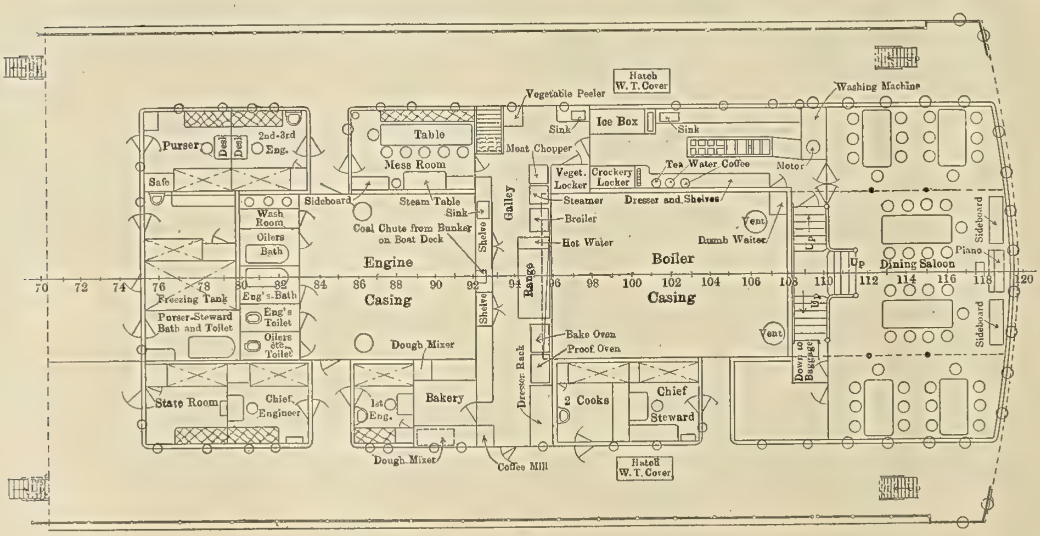
POOP DECK OF THE HONOLULAN.

The tail shaft has a continuous gunmetal bearing, shrunk on. The propeller has a cast steel hub, with four adjustable bronze blades.

The main condenser is of the independent, horizontal, cylindrical type, with 7,000 square feet cooling surface. The air pump is of the single-acting type, and is driven off the main engine by means of levers and links, connected to the low-pressure crosshead. There are also two plunger bilge pumps driven off the air pump crosshead. The circulating pump is of the centrifugal type, driven by a simple 10-inch by 9-inch vertical engine. There is provided a feed-water filter tank, and also a vertical multi-coil feed heater. There is also provided an auxiliary condenser, having 1,000 square feet of cooling surface, and fitted with a combined air and circulating pump.

The other independent pumps located in the engine room are as follows: One main, one auxiliary and one donkey feed pump; one injector; one ballast; one oil trimming (for fuel oil tanks); one fire and bilge; one sanitary and one fresh-water pump.

There are three single-end Scotch boilers, each 15 feet 9 inches diameter, by 12 feet 3 inches long, between heads, built for a working pressure of 215 pounds per square inch. Each

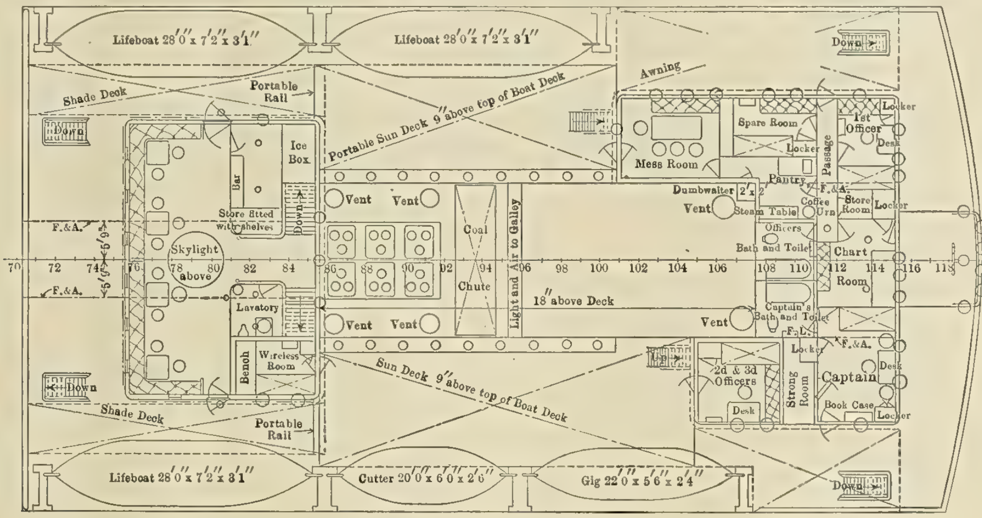


SHELTER DECK PLAN OF THE HONOLULAN.

boiler has four 40-inch furnaces of the Morison suspension type, with separate combustion chambers. These boilers are fitted with hot air forced draft system, for which there is provided one steel plate blower, driven by two simple vertical engines.

The furnaces are equipped for burning fuel oil, and for this purpose there is provided the following: Two main fuel oil pumps; one auxiliary oil pump; two vertical fuel oil heaters and one pressure blower, for atomizing the oil at the burners. The ships also carry the necessary fittings, to enable the boilers to be converted easily into coal burners. For this there is also provided a steam ash hoist ram. For harbor use there is a donkey boiler of the Scotch type, which is 10 feet diameter by 9 feet 6 inches between heads, and built for a working pressure of 215 pounds per square inch.

The other auxiliaries provided are as follows: A distilling system, consisting of two 20-ton evaporators, two 20-inch multi-coil distillers and one aerating tank; one 2-ton refrigerating plant; two 20-kilowatt dynamos; a Clayton fire extinguishing and fumigating system, and a system of hold ventilation, by means of a suction fan.



BOAT DECK PLAN OF THE HONOLULAN.

LIFE SAVING AT SEA.

BY SYDNEY F. WALKER.

The boat question which was considered last month is really only a part of the much larger question of saving life at sea and again there are two distinct problems to be met, that of saving the life of anyone falling overboard, with the ship underway, and that of saving all of the passengers and crew in case of wreck. The two questions merge into each other to a certain extent, inasmuch as the successful solution of both problems depends very largely upon the ability to lower a boat clear of the ship, and to disengage her from the boat falls in such a manner that she floats easily and quickly away from the ship.

As marine engineers know, even the steadiest ships roll in a seaway, and it is more often than otherwise that there is a call for life-saving appliances in a seaway than in a calm. When the ship is rolling heavily it is a very difficult problem to lower a boat into the water, and to disengage her on arrival in the water, without her being thrown up against the side of the ship and smashed to pieces. Tales of wrecks abound in instances where boats that have been lowered have been dashed to pieces, sometimes with crew and passengers in them, sometimes before there had been time to load them. Even with the very greatest care and skill in lowering boats from the ordinary davits, and with the best of disengaging apparatus, the chances of the boat being dashed up against the side, particularly if a ship has a high free board, are very great. In the old wooden frigates the quarter boats that were always ready for lowering were suspended from stout wooden davits, projecting well out from the side of the ship on each quarter, and there was therefore a fair amount of room between the end of the davit and the ship's side, so that if care was taken to lower quickly, when the ship rolled toward the boat, and to disengage immediately she was water borne, the boat got away safely. In smooth weather it was a very simple matter. The writer has seen cases, however, where even with great care boats have been smashed, and the davits, too, by the heavy seas that were pounding against the ship's quarter. With the ordinary iron davit carried by the bulk of the mercantile marine the question of lowering a boat at sea is a very difficult one indeed, if she is rolling at all, because there is so little clearance between the outer ends of the davits and the ship's side. The first part of the problem therefore is the provision of some kind of davit that will give the boat a chance of swinging clear of the ship's side.

DAVITS.

Several attempts have been made to accomplish this, such as the Bevis davit shown in Fig. 1, and that designed by the Messageries Maritimes shown in Fig. 2; the principle of which is the throwing of the end of the davit outboard, under control, so that the boat when lowered is at some distance from the ship's side. The latest, and apparently the best arrangement of the kind, is that invented by Mr. Axel Welin, shown in Figs. 3 to 5, in which the principle for the Bevis davit is extended.

The davit itself is thrown outwards, on its pivot, under the control of screw gear, but the foot of the davit itself is in the form of a toothed quadrant, the teeth engaging in a rack in the base of the apparatus. The davit can be made of practically any form, straight or curved, so that the boat when stowed can lie in any convenient position. When the boat is to be lowered its weight is taken in the usual way by the falls. It is lifted clear of the chocks upon which it has been stowed, and the davits and boat together are swung outboard to the full extent of the quadrant. In the outboard position the outboard end of the quadrant is against the outboard part of the frame carrying the davit, and the fulcrum upon which the davit works is also against the outboard end.

The davit can be designed to give whatever clearance from the ship's side is necessary, and it lends itself to the stowage

of boats in various convenient positions that would be impossible with ordinary davits. In some cases, for instance, the boats are stowed half outboard, thus giving a larger promenade space on the deck, a great convenience in the large passenger liners. In another form, the boat is stowed right inboard on

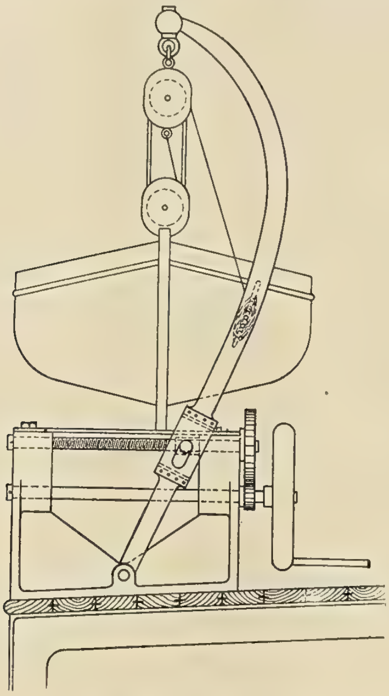


FIG. 1.—BEVIS DAVIT.

top of the cabin, and the davit is made to move through an arc of something like 90 degrees or more, picking the boat up from its stowing place, raising it in the air, carrying it outboard to the position where it can be safely lowered, and in recent installations two boats can be carried under a single set

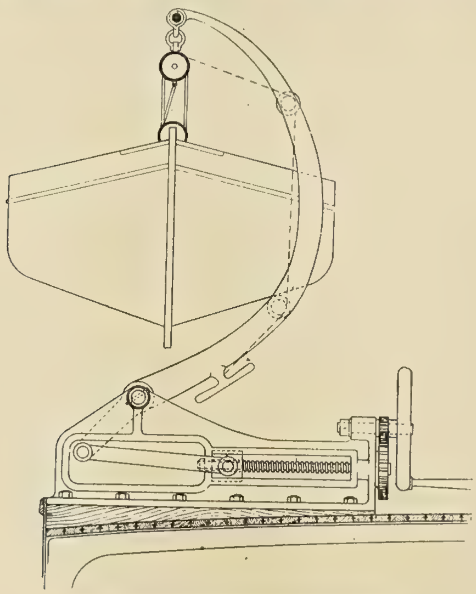


FIG. 2.—MESSAGERIES MARITIME DAVIT.

of davits. In addition to other arrangements the falls have a balancing action, as usually arranged by Mr. Welin, so that in the case of lifting heavy boats they assist the hoisting gear at some part of the lift, as shown in Fig. 4.

An important development also is the special arrangement for handling heavy launches on board of cruisers. The launch has to be stowed well inboard, practically in the equivalent position of that occupied in the old sailing ships, and it has to be lifted from this position and turned right outboard. The operation is the same as we used to perform in old sailing ship days, by combined tackle from the fore and main yards and fore and main masts. In the old days when getting a launch our four tackles were employed, two from the fore and main masts and two from the fore and main yard arms. The tackles from the fore and main masts lifted the boat out of its crutches to a sufficient height to enable it to pass over the hammock nettings. When it was sufficiently high the tackles from the fore and main yard arms were hauled out, and as they took possession of the boat the tackles from the fore and main masts were eased off till the boat hung from the yard arm tackles by which they were lowered into the water.

DISENGAGING APPARATUS.

The problem involved in lowering a boat at sea, particularly in a seaway, has two parts. It is necessary, as explained above, to provide room between the end of the davit and the

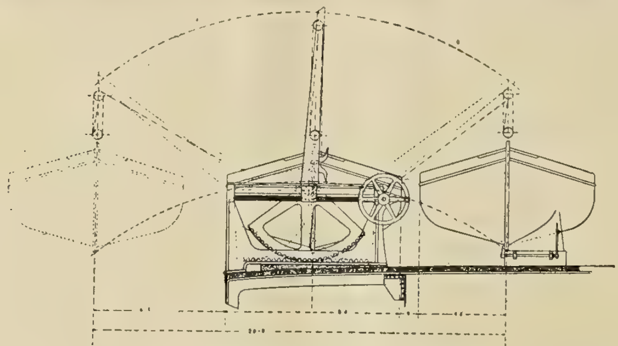


FIG. 3.—WELIN DAVIT WITH 90° QUADRANT.

ship's side, so that the boat will have a chance of swinging clear even if the ship does roll back, and in addition it is necessary to arrange that the boat is instantly disengaged from its falls immediately it touches the water. In certain cases it may be wise even, where it can be done, to disengage before the boat touches the water. Where the ship is rolling quickly, or with a very long roll, if the boat is not actually in the water when the back roll commences it is often a safer plan, where it can be done, to drop the boat from a short distance into the water than to risk her coming up against the ship's side again. In any case the boat must be disengaged immediately she touches the water, or there may be very serious trouble, as the boat may be pulled violently in against the ship's side, or possibly pulled out of the water again and seriously damaged.

There are several appliances on the market for disengaging the boat immediately it is water borne. In all of them the weight of the boat is made use of to keep the suspending gear locked in place, and the absence of its weight, immediately it is water borne, is made use of to enable the suspending gear to be disconected from the falls. For ordinary boat hoisting the usual arrangement is: the boat is hung by a pair of chains, fixed forward and aft in the boat. Both chains are secured to the keelson, and the forward chain is also secured to the stemson, the after chain being secured to the stern post. Each chain has an eye to receive a hook, or to which any disengaging apparatus may be attached. The chains are kept in the center of the boat, so that when hoisting the boat swings level by lanyards between the rings of the chains and eye-bolts in the sides of the boat.

The hoisting gear consists of one of the usual ship's tackles. There is usually a double sheave block below, and in the old sailing ship days there were two sheaves fixed in the davits above, the fall being passed round the two sets of sheaves. With iron davits a second two-sheave block is suspended from the davit to take the place of the sheaves in the old wooden davit. In harbor, where boats are being continually hauled up

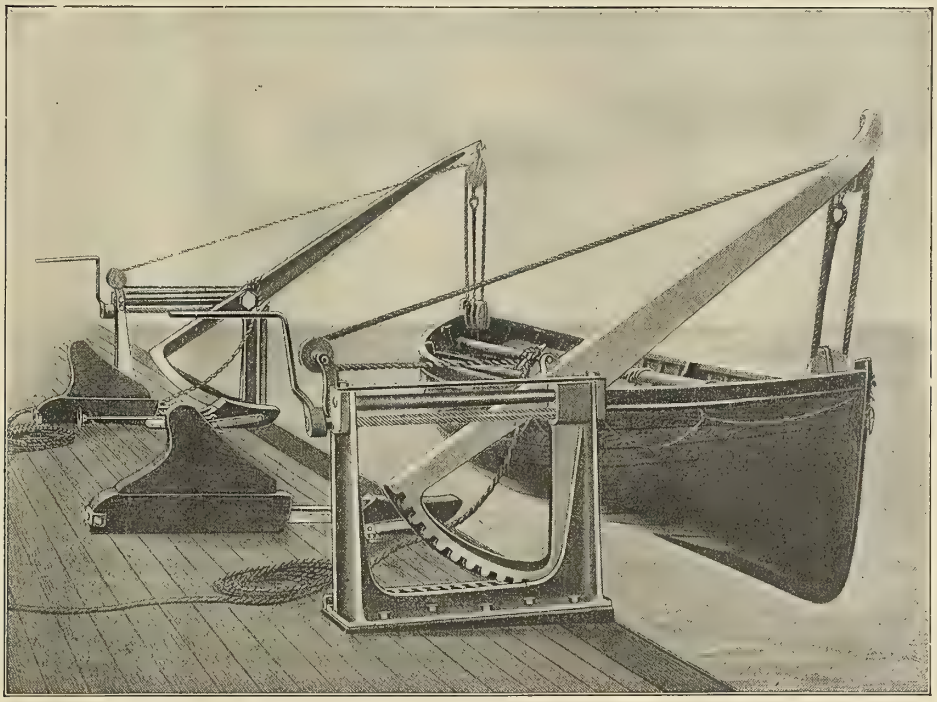


FIG. 4.—WELIN DAVIT, SHOWING BOAT ABOUT TO BE LOWERED.

and down, as in men-of-war, the lower block of the falls carries a hook, which engages with the eye in the chain of the boat, and the boat is hoisted by pulling the two falls together. In men-of-war a sub-division of the watch, or if it is to be done quickly, the whole of the watch would be mustered on the falls. Each fall would be hauled taut separately, the two falls "married," as seamen express it, the men catching hold of both of them together, and run quickly up to the davits. With the heavy boats used in modern battleships the boats are hoisted by winches, usually driven by electric motors, but the same arrangement rules. When the boats are up the ends of the falls are secured around cleats, placed in convenient positions on the davits or just inside the ship. For lowering rowing boats in harbor in men-of-war all that is required is a hand at each fall, a couple of hands in the boat, to keep her off the ship's side and to take charge of her when she is in the water. The hands at the falls allow them to run round the cleat as the boat descends, the cleats being used as brakes till the boat takes the water. With the heavy boats the arrangement would be the same, except that the boat would be swung out and lowered by the winch under control of a brake, and, if necessary, of the electric motor.

FIG. 5.—BOAT DRILL WITH WELIN DAVITS ON STEAMSHIP EUROPE.

At sea it is different. The lower blocks of the falls have eyes, or thimbles, in place of hooks, and the chains in the boats have various forms of hooks engaging with the eyes of the falls, and arranged to disengage instantly when the coxswain or the officer in charge desires. The apparatus employed is, broadly, of two kinds. There are always hooks, but in some forms of disengaging apparatus the hook is made to tumble clear of the eye when the boat is water borne, and in other cases it has to be pulled out, so as to release the eye.

In the Linkleter apparatus, drawings of which are shown in Fig. 6, it will be seen that there is a tumbling hook. Attached to the suspending chain in the boat is a casting, with a slot,

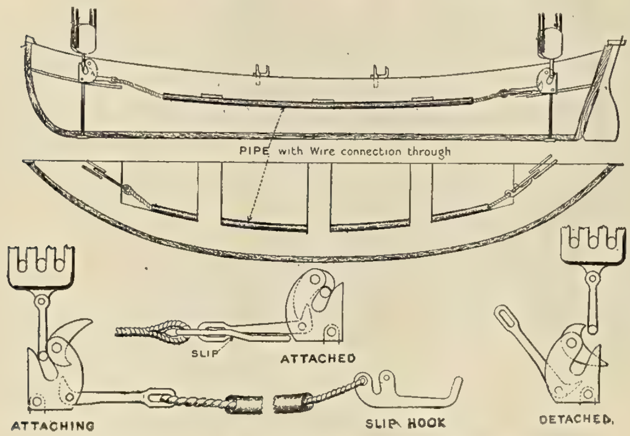


FIG. 6.—DETAILS OF LINKLETER DISENGAGING APPARATUS.

into which the eye of the falls slips, and out of which it can slip easily when allowed to do so. When in place, and the boat is to be hoisted, the tumbling hook shown is turned over and locks the eye in position. The tumbling hook and the slotted fittings together form a ring, holding the ring of the falls so long as the hook is in the locked position. The tumbling hook is kept in the locked position by the second hook shown. The fitting which locks the tumbling hook is really another tumbling hook. It is pivoted upon another pin in the slotted fitting, and when the falls are to be held in place the slip hook, as it is called, holds one end of the tumbling hook, as shown in the drawings, so that it cannot move backward, and therefore holds the eye of the falls in place. The slip hook is kept in its position by the device shown. An eye in the end of the hook is passed over a lug in another fitting attached to a rope running fore and aft in the boat, and is held in its place by a pin. The rope passes through a pipe in the boat, and is conected to the two slip hooks fore and aft. It is slipped by releasing the after hook. When the boat is water borne the after hook is slipped, both slip hooks are then released, and the eyes of the falls are free to push the tumbling hooks holding them in place back to slip out of the slots, and the boat is free. The slip hook is put in operation by the coxswain, or the officer in charge of the boat, and he must judge the instant when it can be done with advantage. Upon his judgment depends the lives of those in the boat.

The Mills disengaging apparatus shown in Fig. 7 has also a

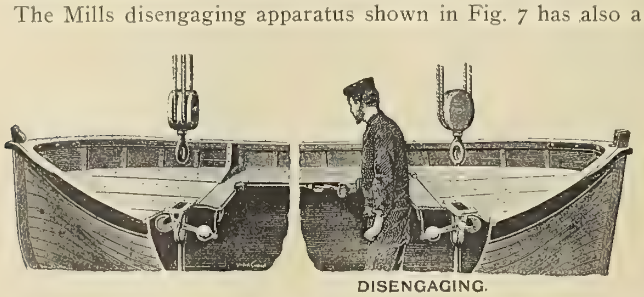


FIG. 7.—MILLS DISENGAGING APPARATUS.

tumbling hook. The arrangement is somewhat different than that of the Linkleter. The falls have the eyes, as in all cases, and the boats in place of the chains described for suspending them have stanchions fixed in the keelson, forward and aft, the stanchions ending in crutches with slotted plates above them. In the crutches are pivoted the tumbling hooks, and the slotted plates above are to hold the eyes of the falls in position. The tumbling hook is very simple indeed in arrangement. It consists merely of a lever, with a hook at one end and a balance weight at the other. Attached to the balance weight is a rope leading over pulleys to the center of the boat, the ropes from the two hooks being connected together, and to a handle, which the man who is to release the boat grasps. This is the apparatus, the only one so far as the writer is aware, which enables the boat to be released before it is water borne.

The usual arrangement is, when the boat is to be hoisted, the eyes of the falls are pushed down through the slots in the stanchion plates in the boat, and the hooks are engaged with them, the hook and the slotted plates together forming a sufficient lock, so long as the weight of the boat is upon the falls. When the boat touches the water, and its weight is taken off the falls, the coxswain, or whoever is to release the boat, pulls sharply upon the ropes attached to the two tumbling hooks, causing the hooks to fall backwards, releasing the blocks, and with it the boat. The boat, therefore, can be released before its weight has been taken by the water if sufficient force can be brought to bear upon the tumbling hooks to release them from the eyes of the blocks.

Hills disengaging apparatus differs from the others in the fact that the hook has to be pulled clear when the boat is water borne. As the writer understands, it is not possible to disengage the boat so long as its weight is upon the falls. As will be seen by the drawings (Figs. 8 and 9) there is a stanchion, forward and aft, somewhat similar to that with the

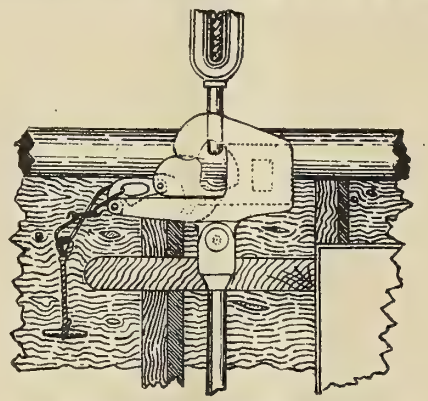


FIG. 8.—HILLS DEVICE CLOSED AND LOCKED.

Mills apparatus, the stanchion carrying a slotted fitting above in which the engaging and disengaging apparatus is fixed. The main slotted fitting, it will be seen, nearly forms a hook. It is a hook, providing there is no vibration, and that something is present to prevent the eye of the falls slipping over the end of the hook. The eye of the falls is kept in position, when the boat is at the davits, by the sliding piece shown in Figs. 8 and 9, which forms with the main portion of the fitting a complete eye or ring just as the tumbling hook does in the Linkleter.

When the boat is at the davits, and the weight of the boat is on the falls, the eye is locked in the compound ring formed by the fitting. Disengaging is performed by pulling the sliding piece out of the main fitting, the action of pulling this out also bringing the eye of the falls out and providing it with clearance. The two sliding fittings, the one forward and the one aft, are connected together by a rope, and can be released by pulling on the toggle at the end of the rope after it has

passed through the block, or the boat can be released by simultaneously pulling on the two short pieces of rope, using the toggles for the purpose.

Another form of releasing hook on slightly different lines made in America is the Raymond. It has a tumbling hook attached to the lower block of the fall of a special form, which

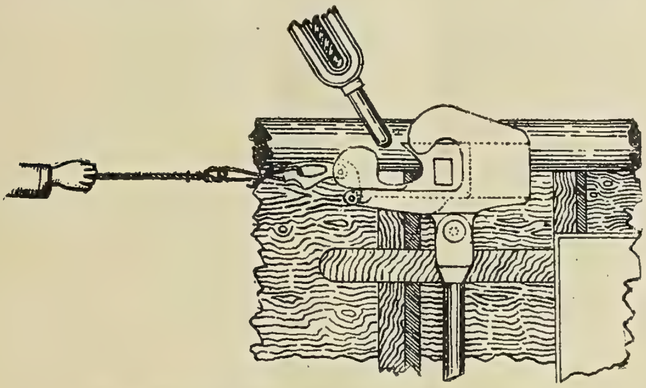


FIG. 9.—HILLS DEVICE UNLOCKED AND DISENGAGED.

it is claimed releases very easily. The bill of the hook carries a lanyard, by which hooking on when the boat comes alongside is facilitated, the lanyard assisting in turning the tumbling part of the hook over. The lanyard is also employed to mouse the hook when the boat is at the davits. Another feature of this apparatus is, the falls are in one continuous length, not in two, as is usually arranged, so that though there are two hands lowering it is not easy for either end of the boat to be lowered before the other. The standing parts of the falls are carried through blocks arranged for the purpose, either attached to the end of the davits or to a spreader fixed between the davits. To the middle of this part of the falls also is attched what is practically a life line, a lanyard secured to the middle of the fall, which is useful to catch hold of when the boat comes alongside. The hooks tumble as usual when the boat is water borne.

One important point in all forms of disengaging apparatus is that the two falls shall be disengaged together, and the makers of all the apparatus claim that it is impossible for one fall to be disengaged without the other. As in other cases the secret of success with all of these devices lies in keeping them in proper order.

BOAT DRILL.

One of the most important factors in connection with saving life at sea is being prepared when the occasion arises. Broadly, there are two occasions that have to be provided for—the case of "man overboard" and the case of wreck. For both it is necessary that boats shall be ready to lower instantly, that their crews shall be ready to man them, that whatever arrangements are made for lowering them, for throwing them outboard, so as to give them room for lowering and for disengaging, should always be ready for instant use, and all this is only to be obtained by frequent practice. Boat drill is, or should be, one of the most important parts of the routine of every ship, large or small. In too many cases lives are lost and other disasters occur because when boats are wanted, and they are always wanted at very short notice, the men who should handle them are not familiar with the work they are to do, and the apparatus itself is not always in proper order. A great deal can be done in ten minutes if everybody knows his place and if the apparatus is all in working order.

The eighteenth annual meeting of the American Society of Naval Architects and Marine Engineers will be held at the Engineering Societies' Building, 29 West Thirty-ninth street, New York City, Nov. 17 and 18.

THE FIRST ITALIAN TURBINE PASSENGER STEAMER.

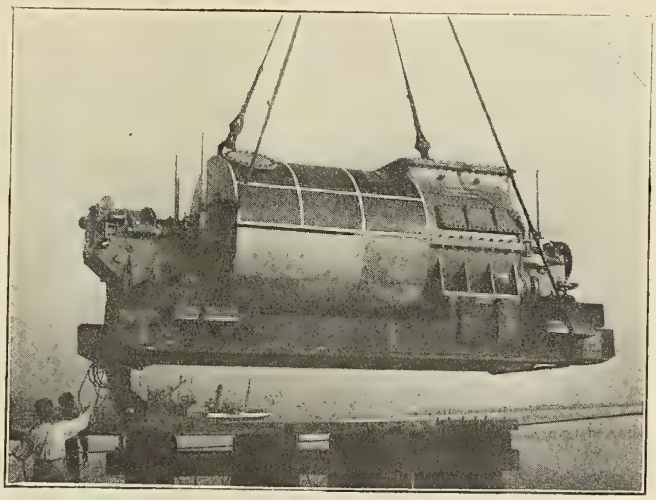
BY DAGNINO ATTILIO.

The *Citta Di Catania,* which ran her full speed trials on June 25, is the first Italian steamer fitted with turbine machinery constructed in Italy. She was built at the yards of Messrs. Gio. Ansaldo Armstrong & Company, at Sestri Ponente, to meet the requirements of Italian Shipbuilding Regulations (Registro Italiano), under order of the State's Railway Department, for passenger service between Naples and Palermo. The general particulars of the vessel are as follows:

Length over all	363 feet.
Length between perpendiculars	346 feet.
Breadth	41 feet.
Depth	30 feet.
Corresponding displacement	3,400 tons.
Speed in service	20 knots.
Designed speed on trial	22 knots.
Shaft horsepower	12,000

PROPELLING MACHINERY.

The turbine-propelling machinery is of the Parsons type, having the three-shaft arrangement now usually adopted for merchant steamers, with one high-pressure turbine coupled to the center line of shafting, and one low-pressure ahead and and an astern turbine incorporated in the same casing coupled to each wing shaft. The starboard and center propellers are right-handed, and the port left-handed. The diameter of the rotor drum of the high-pressure turbine is 3 feet 11¼ inches, the low-pressure 5 feet 6 inches, and the stern rotor drum 4



STARBOARD LOW-PRESSURE TURBINE OF THE CITTA DI CATANIA.

feet 2 inches. Each line of shafting drives one solid manganese bronze propeller.

The turbines of the *Citta Di Catania* are the first set for an Italian passenger steamer, and are the first set manufactured by Messrs. Gio. Ansaldo Armstrong & Company in their works at Sampierdarena, since they obtained the right for manufacturing the Parsons turbine in Italy. The rotor wheels are cast steel, the spindles of forged steel of special quality and the casing of cast iron. The blades are of hard-drawn brass, and are fixed in the rotors and casings in accordance with Parsons usual design.

The adjusting blocks, which are incorporated in the turbines, are so constructed that they admit of being readily adjusted while the turbines are running. The handles of all

starting and maneuvering valves for the ahead and astern turbines are accessible from the starting platform at the forward end of the engine room, and are operated entirely by hand, so that one engineer can have entire control of the whole machinery. With this arrangement the port or starboard turbine is capable of being worked ahead or astern independently of each other and of the high-pressure turbine, the latter rotating idly when maneuvering.

The lagging of the turbine casings is arranged on an improved design, the result being a very small loss of heat by radiation. This result is obtained by supporting the magnesia lagging blocks so as to give an air space of about 4 inches between their under surface and the surface of the casings.

A governor, working in conjunction with the high-pressure turbine throttle valve is fitted at the forward end of the turbine bearing. It is driven by worm gear from the rotor spindles. The governor on each shaft is arranged to act independently and close the throttle valve in the event of the shaft breaking, or the speed of the turbines exceeding the limit at which the governors are set (600 revolutions), owing to the propellers racing in a seaway.

LAUNCHING OF THE CITTA DI CATANIA.

Chadburn's patent counters and tell-tales are fitted to the forward end of the turbine, and are so arranged that the engineer on watch can, from the starting platform, see not only the direction of rotation of each shaft, but also the number of revolutions of each shaft.

Each low-pressure turbine exhausts into a separate condenser of the Uniflex type, with steel plate shells, the total cooling surface in the two condensers being 8,998 square feet.

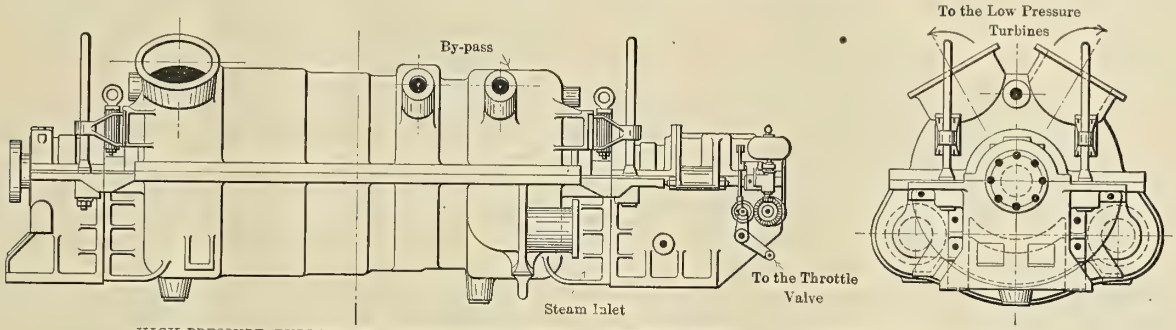
The two circulating pumps are of the centrifugal type, each driven by a separate reciprocating engine, 11 1/16 inches in diameter by 11 1/16 inches stroke; the suction and delivery pipe being 23 inches diameter; the wheel is 44 inches in diameter, and runs at 225 revolutions. The air pumps are of Weir-Dual's latest type for wet and dry air suction; the diameter of each pump is 22 inches and the stroke 16 inches. The exhaust steam from the auxiliaries is led into a surface heater, through which the feed water is circulated on its way to the boilers. The feed water is passed through a filter, and is then delivered to the boilers by one pair of Weir's double-acting pumps, 13 inches diameter and 26 inches stroke. Two of Weir's direct-acting pumps, 5 inches diameter and 12 inches stroke, are fitted for supplying oil under pressure to the turbines, one for ordinary working and the other for stand-by purposes. One Weir direct-acting pump, 8 inches diameter by 10 inches stroke, is fitted for circulating water into the oil cooler. There are also one 20-ton pump for sanitary use for washing decks, one 60-ton pump for See's ash ejectors, one 70-ton pump for fire, bilge and ballast purposes, and one 6-ton pump for fresh water.

There are also two large self-lubricating, steam-driven dynamo sets. The distilling plant consists of one Bonsignori evaporator, capable of producing from sea water 20 tons of fresh water per twenty-four hours. There is an auxiliary condenser located just beyond the main condenser, fitted with water circulating and air pumps, each situated at the ends of the steam cylinder and working in a horizontal position.

SPEED TRIAL.

On the six hours' trial the ship mantained, with ease, an average speed of 23 knots, and on a portion of the run her speed was 23.4 knots, the mean power, measured with a Denny & Johnson's torsion meter, placed on each shaft, being 13,600 horsepower, and the coal consumption 1½ pounds per horsepower per hour. The air pressure in the boiler furnaces was ¾ inch of water. The number of revolutions was 510, and identical in the case of all three turbines, a remarkable fact, which shows that the radial *blade clearance* in the turbines, *especially,* is actually *as designed.* During the trial the *dummy clearance* in the high-pressure and low-pressure turbines, measured by *micrometers* and controlled by *finger-pieces,* was .02 inch and .024 inch, respectively; the steam pressure in the port of high-pressure turbine was 150 pounds and 23 pounds in the low-pressure turbine, just in the annular space before the first expansion; the steam pressure in the boilers was 180 pounds per square inch, while the condenser vacuum was 27½ inches. The opening of the stop valves on the boilers was only *two turns corresponding to half of the full opening.* More opening caused priming. The temperature of the oil in the bottom of the turbine bearings was 110 degrees F.

Absolutely no vibration was felt in the ship, as the greatest care was taken in the static and dynamic balancing of the rotors, and it can be justly claimed that the first turbine merchant ship built in Italy represents a new triumph for the Parsons turbine system.



HIGH-PRESSURE TURBINE OF THE CITTA DI CATANIA, SHOWING STEAM CONNECTIONS AND GOVERNOR.

Steam is supplied by ten single-ended boilers, 14 feet 1¼ inches diameter by 11 feet 2⅝ inches long, with three Morison furnaces, 3 feet 10½ inches outside and 3 feet 7⅜ inches inside diameter in each. The working pressure is 170 pounds per square inch, the grate area 614 square feet for the ten boilers, length of grate 5 feet 9⅜ inches, and heating surface 26,050 square feet. There are 372 tubes in each boiler, with an outside diameter of 2¾ inches and 8 feet 2½ inches in length. The steam chamber contains 3,531 cubic feet, and the stop valve is 4⅝ inches in diameter.

The boilers are arranged in three compartments; four in the central and aft compartments and two in the fore compartment; there are three elliptical funnels; two of them measure 8 feet 10 inches by 6 feet 9 inches, and the other 8 feet 10 inches by 4 feet 7 inches. The funnels are double, the space between the inner and outer funnel being utilized for ventilating the boiler rooms and stokeholes. The boilers work under Howden's forced draft system; air being provided by five large fans, driven by suitable closed self-lubricating steam engines. See's ejectors are fitted, one for each group of boilers, while for harbor duty two steam ash-hoisting engines are provided.

The propellers are three-bladed, of the following dimensions, viz.: Diameter, 6 feet 6¾ inches; pitch, 5 feet 10 11/16 inches; projected surface for three blades, 20 square feet; developed surface, 22 square feet.

COLUMN TABLES FOR SHIP WORK.

BY R. EARLE ANDERSON.

In pursuance of its policy of bringing about, as far as practicable, uniformity of practice in the design of details on vessels building for the United States navy at the various shipyards, the Bureau of Construction and Repair has recently issued a set of column tables, arranged with particular reference to the requirements of ship work.

The work of preparing these tables, under the general direction of the officer in charge of design work, fell to the writer, who found it necessary, in order to determine the proper basis for the construction of the tables, to undertake a general review of existing experiments, formulas and professional opinions relating to the strength of compression members.

With the exception of a few tests of a limited nature made at the Norfolk navy yard and referred to later, no tests were undertaken, because where existing data did not cover the ground as fully as might have been desired (as for example in the case of columns of brass, bronze, etc.), the number and extent of the tests that would have been required to constitute really reliable data were such as to render it impracticable to make them. It should be noted that while a very small number of tensile tests will give a satisfactory index to the corresponding characteristics of a material, the same is

not true in the case of column tests, small groups of such tests being frequently misleading. The failure fully to appreciate this fact has been responsible for much of the diversity found in the various accepted column formulas.

It is believed that the review of information relative to column strength, and the conclusions drawn therefrom, will be of interest. There are appended tables of least probable ultimate strengths of columns of various materials. The writer is not aware of the existence of any column tables equally as extensive as these in the range of materials covered. It is upon these tables of least probable ultimate strength that the construction and repair tables of safe unit loads are based. The ultimate strengths are not given in the construction and repair tables, because, owing to the somewhat unusual method adopted of applying the factors of safety as explained below, it was feared that some confusion might result.

REQUIREMENTS FOR SHIP-WORK COLUMN TABLES.

In the preparation of tables of allowable column loads for use in connection with work on ships certain fundamental principles should govern:

(*a*) The tables should have a wide range of applicability. Their use will not be similar to that of tables or formulas intended for bridge design or for structural steel work generally. The latter purposes have formed the basis of the column tables and formulas now generally in use by the engineering profession. In the design of a single, large and important structure, such as a large bridge, careful consideration can be given to the conditions which will obtain for the compression members, and the formulas can be modified accordingly. No such detailed consideration can be given to the various cases of compression members occurring in ship work. It is not probable that secondary stresses will be cared for to any extent in the detail designs, and the tables must therefore contain an allowance for such secondary stresses as are likely to occur.

(*b*) The range of applicability should be great, not only as regards the use to which the column or strut is to be put, but also as to the length ratios. It is unusual in structural engineering practice to meet with values of l/r much beyond the range of 25 to 100, the common values lying close to 50. For the range of uses to be met with in ship work, l/r may run from 25 to 250, and the tables should be reliable to 300. The fact that most compression members in ordinary structural engineering practice have l/r near to 50, has led to the adoption of some formulas which are reasonably reliable only between narrow limits, *i. e.*, 25 to 100.

(*c*) The tables should be applicable to the following range of materials: Wrought iron, cast steel, medium steel, high tensile steel, the several grades of steel used for forgings, the various brasses and bronzes, oak, ash, yellow pine, Douglass fir (Oregon pine), white pine and spruce.

(*d*) Tables are preferable to formulas because more convenient for general office use. The formulas upon which the tables are based need not therefore be simple in form. The desirability of simplicity in formulas where they are to be used as such instead of being tabulated has led to the adoption for general engineering use of several formulas not otherwise entirely advantageous.

(*e*) Finally, the tables should be arranged for use with various factors of safety, giving safe loads that will provide the same relative strength for compression members as for tension members when the design is based upon any allowable tensile stress.

TEST DATA.

Practically all reliable published tests on compression members up to 1900 are collected and cited by Moncrieff (Trans. Am. Soc. C. E., Vol XLV.). The materials and the number of tests for each material are as follows: Cast iron, 281; wrought iron, 2,059; mild steel, 230; hard steel, 30; yellow pine, 99; white pine, 66; oak, 49.

It will be seen that by far the greatest number of tests have been made on wrought iron, and practically all accepted formulas and tables rest mainly on the wrought iron tests. The above tests include both small and large specimens, the greater number being small. They include integral and built-up sections, with all types of ends.

The most important of the above tests are those of Hodgkinson (1840), Christie (1884), Tetmajer and Marshall (1887). Other tests included in the above summary were made by Bauschinger, Bouscaren, Strobel, Dagron, Lanza, Kirkaldy, Lamonde and the Watertown Arsenal. For references to original authorities see the bibliography in a later section.

Since 1900 a number of tests have been published which do not greatly change the relative number of tests available for the different materials. A few tests on large members of nickel steel have been made (Waddell). The Quebec Bridge Commission tested a single model of a chord member of the Quebec Bridge, one-third size. The test proved that the detailing of the member was faulty.

The American Society for Testing Materials has outlined a comprehensive series of tests of columns. These tests are being carried out at the Watertown Arsenal; a small part of the programme has been completed and the results published. These tests will be discussed later under the heading "Fixed and Flat Ends."

A number of tests have been made by Prof. Lilley, and are discussed in *Engineering* for Jan. 10, 1908. The original description of these tests has not been available. The tests were made with a view to determining the effect of the shape and relative dimensions of the cross section. A similar set of tests on seamless tubing was made by direction of the Bureau of Construction and Repair at the Norfolk navy yard. The Lilley tests and the Norfolk tests are discussed under the heading "Effect of Form and Thickness."

PRESENT ACCEPTED FORMULAS.

In the discussion of all formulas the following symbols will be used, and formulas as given by the various authorities are changed to agree therewith:

p = Average load per square inch on the column.
P = Total load.
f = Stress per square inch in the extreme fiber.
f_t = Ultimate tensile strength of the material in pounds per square inch.
E = Modulus of elasticity.
e = Eccentricity.
r = Radius of gyration in inches.
l = Length of column in inches.
y = Distance from neutral axis to extreme fiber.

All the formulas discussed in this section are (where not otherwise stated) for ultimate unit loads.

(*a*) *Euler's Formula.*—This is a rational formula applicable only to long columns which may fail by bending without causing a crushing stress in the most stressed fiber; that is to say, the column fails by elastic instability. It was published by Euler in 1759. The formula is derived by determining the relation between the load and the deflection when this relation is such that any increase in the load will cause the deflection to become infinite. The formula assumes that a small deflection does take place, which is then increased by the load, and that the load is truly central; also that the column is free from any resistance to bending at the ends. The formula is as follows:

$$p = \frac{\pi^2 E}{(l/r)^2}$$

On substituting the value of π^2

$$p = \frac{9.87 E}{(l/r)^2}$$

Authorities differ as to the value of l/r below which this formula is inapplicable. Some put this as low as 100 (Johnson's straight line formula intersects a modification of Euler's curve at $l/r = 100$). The authorities which consider Euler's formula applicable to relatively low values of l/r generally average the results of experiments rather than take the lower limit of the experiments; this matter will be discussed later. Comparison with formulas and experimental data considered later in this paper indicates that Euler's formula gives practically correct results for the ultimate strength when l/r is greater than 175.

Attempts have been made to apply Euler's formula to various types of ends by putting an empirical constant in place of π^2 (T. H. Johnson, Trans. Am. Soc. C. E., Vol. XV.). The results are not rational nor satisfactory, nor is the method necessary.

The elastic curve according to Euler's formula is a curve of sines.

(*b*) *Rankine's Formula.*—This formula was originally proposed by Gordon. Rankine modified the formula to the form in which it is now used. The formula was based on Hodgkinson's experiments on small wrought iron and cast iron specimens. This basis has remained without serious amplification. It is the formula given in most of the handbooks, including Carnegie and Cambria, and is the basis of the general column tables in these books, although for the tables given in the handbooks, for particular forms of columns, such as those made up of Z bars or channels, some modification of the straight line formula is generally used.

Rankine's formula is as follows:

$$p = \frac{f_t}{1 + C\ (l/r)^2}$$

The constant C is purely empirical, and is intended to represent both the material and the type of ends. The formula can be derived rationally but the assumptions made in its derivation are not really justified. The term f is usually taken at less than the ultimate strength of the material, and hence becomes an empirical constant. The entire formula is thus to be considered as empirical. It is generally taken as applicable to all values of l/r, but as it intersects Euler's curve at $l/r = 95$ (in the case of medium steel, pin ends), and is much above Euler beyond this value, it should not be considered as generally applicable to all values of l/r. This formula *averages* results of tests. Carnegie gives the formula for medium steel, pin ends, as follows:

$$p = \frac{50{,}000}{1 + \dfrac{l^2}{1{,}800\ r^2}}$$

The formula contains no factor for eccentricity and assumes the elastic curve as an arc of a circle.

(*c*) *Johnson's Straight Line Formula.*—This formula is confessedly empirical, and represents an attempt to express the average of test results by means of the simplest possible formula. The result is a straight line, tangent to Euler's curve. The equation to the straight line is:

$$p = K - C\ l/r$$

He takes K as the strength at $l/r = O$, and determines C from the relation necessary to make the line tangent to Euler's curve. For wrought iron, round ends, he gives as the equation to the straight line:

$$p = 42{,}000 - 203\ l/r,$$

and for Euler's curve uses $E = 27{,}000{,}000$. The point of tangency is at $l/r = 135$. For other materials and types of end, the point of tangency varies from $l/r = 75$ for cast iron with round ends to $l/r = 210$ for wrought iron with flat ends.

He compares his formula with the then available (1885) data on cast iron with round and flat ends, wrought iron with flat, hinged and round ends, mild steel with flat ends, hard steel with flat ends and oak with flat ends.

As the constants for each of these materials have to be separately determined for each material, there is not a satisfactory basis for passing from one material to another for which complete experiments are not available.

Johnson gives, in addition to his formula for the average of each set of experiments, a formula for a lower limit and one for an upper limit. To do this he modifies the constants in the straight line formula and changes E in Euler's formula. To modify E does not seem rational.

This straight line formula, variously modified, has become the most accepted formula in American practice, principally because of its simplicity and consequent convenience. For the limited range required for bridge and similar work it is sufficiently accurate.

Mr. C. C. Schneider (Quebec Bridge Report) criticizes the formula as being too high for $l/r = O$ and too low at its point of tangency to Euler's curve.

Accordingly, he proposes the following modifications, basing his strength at $l/r = O$ on results found by Tetmajer:

Wrought iron, $p = 43{,}100 - 183\ l/r,\ (l/r \leqq 112)$.

Medium steel, $p = 45{,}700 - 165\ l/r,\ (l/r \leqq 105)$.

These are for pin ends.

The American Railway Engineering and Maintenance of Way Association adopts the formula in the following form for *safe loads:*

$$p = 16{,}000 - 70\ l/r$$

(*d*) *Pencoyd Tables.*—These are based on the tests made by Christie (Trans. Am. Soc. C. E., Vol. XIII., 1884) on relatively small specimens of wrought iron, medium and hard steel, with various types of ends. The majority of the tests were on wrought iron. The tables are apparently intended to average the results. They do not plot into a fair curve. The tables for safe loads include a factor of safety which increases with increase in l/r. The curve for round ends lies much below Rankine's formula, the value being about one-half at $l/r = 150$. The curve is practically coincident with Johnson's original straight line formula from $l/r = 50$ to $l/r = 125$, and beyond 125 it is close to, though slightly below, Euler's curve.

(*e*) *Comment on Accepted Formulas.*—It is evident from the above that none of the formulas in common use fulfills the requirements laid down at the beginning of this article.

Euler's equation is correct for very long columns only, most of which lie beyond the range of usefulness.

Rankine's formula is to be regarded as entirely empirical; it gives too high values for the longer columns even within the range of greatest use; its original basis of test data is insufficient; and it gives no satisfactory means for passing from one material to another. With the possible exception of the straight line formula, Rankine's formula is the most used column formula in existence, which is unfortunate, as it is the least accurate of all (provided the limited applicability of Euler's formula be allowed for), and generally gives results which are much too high.

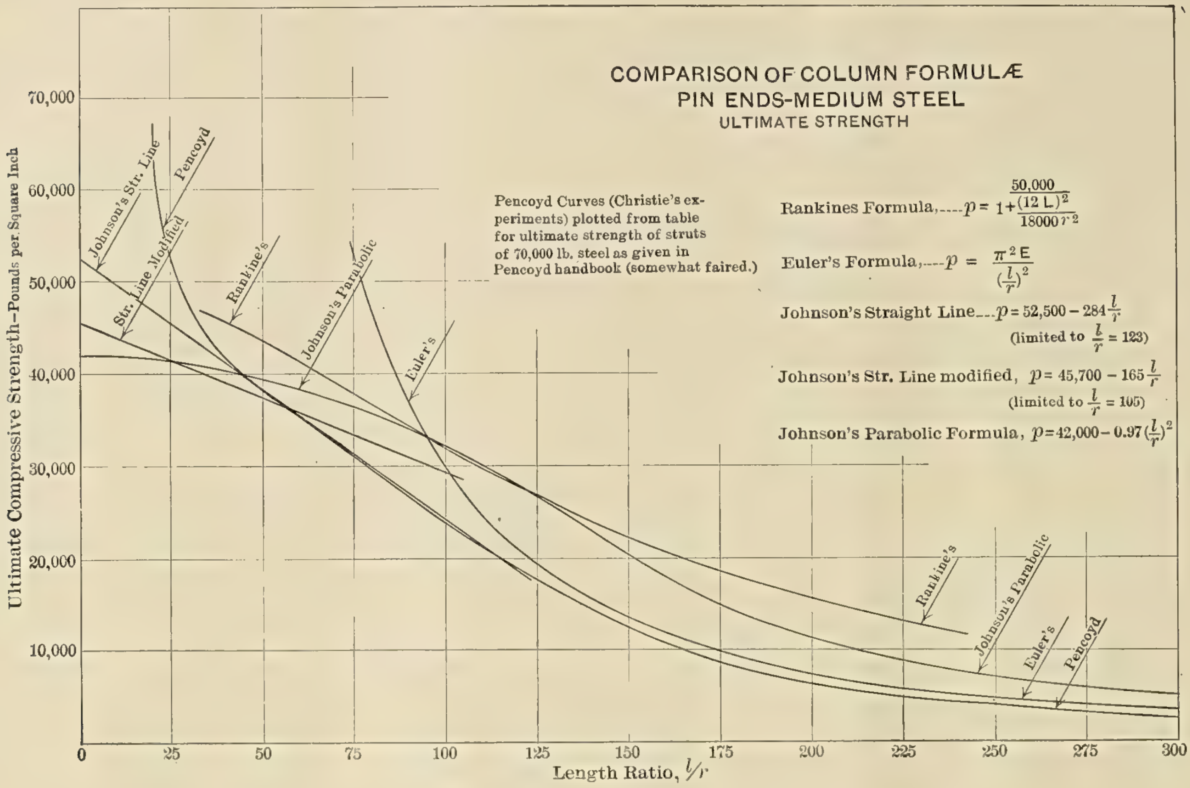


FIG. 1.

Johnson's straight line formula, while extremely useful for the purposes for which it was intended, is limited in its applicability as to both material and range of l/r, and a satisfactory basis for passing from one material to another is lacking.

The Pencoyd tables are based purely upon experiment, and hence, while trustworthy for the actual materials represented in the tests, give no means of passing from one material to another.

All of the above formulas and tables are open to criticism, also because they are intended to average the results of tests rather than to assign a lower limit to them. This will be discussed in the succeeding section.

The various formulas are shown in the form of curves in Fig. 1, from which their great divergence is apparent.

(To be continued.)

THE MARINE STEAM ENGINE INDICATOR—XV.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

The admission line, *AB* of Fig. 95, shows how steam is admitted to the cylinder. The admission line should be straight, vertical and at right angles to the atmospheric line, and can usually be made so if the valve is open a proper amount to steam when the crank pin is crossing the dead center. At this part of the crank revolution the piston is practically at rest or moving very slowly, and a small opening is sufficient to run the pressure up to that of the valve chest. As the piston moves away from the cylinder end its speed rapidly increases, reaching a maximum at about half stroke, and if the valve is at all late in opening it is easily seen that it will be impossible to run up the pressure instantly in a space whose volume is rapidly increasing, and this through the small area of the initial valve opening. If the valve is thus delayed in opening the admission line leans inward and decreases the area of the diagram to no useful purpose.

The proper form is shown at *VI*, Fig. 96. This is a portion of a card taken from the high-pressure cylinder of a compound engine fitted with Corliss valves. The steam valve opens at *A*, with the piston practically on the dead center, the pressure runs up at once, but not so quickly that the inertia of the pencil motion of the indicator carries the pencil beyond the height due to the valve chest pressure, which will cause a sharp point at the top of the admission line as at *B* on diagram VIII. This sharp point is one of the indications of too much lead; *lead* being defined as the opening of the valve to steam when the engine is on the dead center. Diagrams I to V were taken from a slide-valve engine, whose valve gear was purposely deranged to show the effects of bad valve adjustment. Diagram I was taken with the valve set so that all the events would be very late. The exhaust port closed at *C* just before the engine reached the center, compressing the imprisoned steam and causing the pencil to rise a little. The piston then commenced to move to the right, the steam expanding, and in consequence causing the pressure to drop, the pencil going around the loop in the direction of the arrows. The pressure continued to fall until it reached the point *A*, when steam was admitted and the pencil rose slowly, as shown. By the time the piston reached *A* it was moving at considerable speed, and as the valve was open only a small amount at first the pressure could not rise instantly, thus causing the admission line to lean to the right. The engine was stopped, the eccentric advanced and diagram II taken. This resulted in earlier compression and admission, as shown. The eccentric being again advanced the events were still earlier and the loop had almost disappeared, but there was no lead and the admission line still leaned to the right. At *IV* a small amount of lead was given, and the admission line found to be correct, the line being vertical with no point at the top. The valve was then given excessive lead and diagram V resulted. At *C* compression commenced, the pressure in-

creasing before the advancing piston until the pencil reached *A*. At this point the valve opened to steam, but the pressure being higher in the cylinder than in the valve chest, the steam blew back into the latter, the inertia of the mechanism carrying the indicator pencil below the chest pressure. The pencil shows the true pressure at *B* as the stroke commences.

Diagram VII is from a Corliss engine, and shows too little lead, VIII being from the same engine and showing too much lead, the admission line leaning to the left. Diagrams IX and X were taken from a high-speed engine driving a dynamo, and show late openings to steam in both cases as well as excessive compression.

The setting of valves on single-valve engines is more or less of a compromise, any alteration of the eccentric or valve stem lengths causing alterations in all of the valve events. Generally speaking, the lead should be the least amount which will

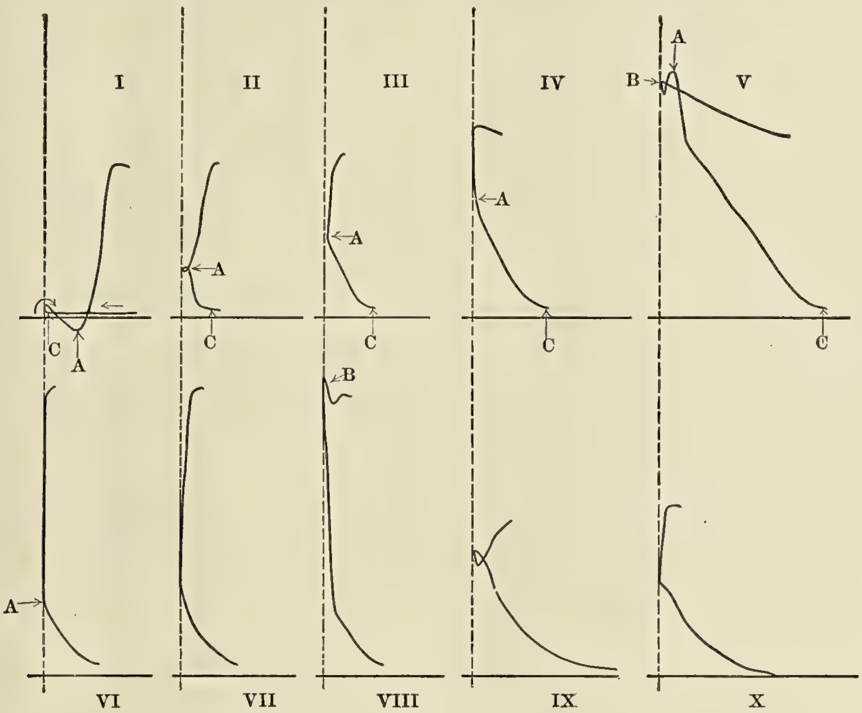


FIG. 96.

produce a vertical admission line with a slightly rounded corner at the top. If circumstances are such that the line must lean in either direction it should be in the direction shown in diagram VIII, as this helps towards a good port opening, which will in turn assist in maintaining the steam line at its proper height. It is the usual custom to adjust the valve stem or spindle length in such manner that the lead will be greatest on the bottom, but the difference, if any be necessary, must be determined by the indicator.

(*To be continued.*)

According to the plans of the engineer-in-chief of the United States navy, an experimental producer gas plant will be fitted on one of the new colliers, if congressional authority can be obtained for the diversion of a portion of the appropriation for steam machinery. Efforts in this direction, however, will not be made unless such an expenditure shall be deemed advisable by the authorities. There is every reason to believe that a suitable and efficient gas producer plant could be built at the present time for one of the new colliers, and, in view of the value of the data which would be obtained from its performance, such an experiment would be well worth trying.

TORPEDO BOAT DESTROYER ROE.

Ten torpedo boat destroyers, the *Paulding, Drayton, Roe, Terry, Perkins, Sterret, McCall, Burrows, Warrington* and *Mayrant,* were authorized by act of Congress, approved May 13, 1908. All of these vessels, which are now building or completed, are fitted with steam turbines and are designed for burning oil fuel. The *Perkins* and *Sterret* have Curtis turbines, the *Mayrant* and *Warrington,* Zoelly turbines, and the other six vessels have Parsons turbines. They all have closed fire rooms.

The contract for the *Roe* and *Terry* was awarded to the Newport News Ship & Engine Building Company, of Newport News, Va., in October, 1908. The contract time was twenty-four months and the price $620,000 (£105,000), which is exclusive of equipment, etc.

The contract requirements were:

Length over all	293 feet 10½ inches.
Length between perpendiculars	289 feet.
Breadth	27 feet.
Mean draft	9 feet.
Coefficient of fineness, block	.41
Capacity of fuel oil tanks	210 tons.
Displacement	742 tons.
Total horsepower	12,000
Speed	29½ knots.

Armament: Five 3-inch 50-caliber semi-automatic guns, three 5-meter by 45-centimeter deck torpedo tubes, three 3-inch guns; all of which are furnished by the government.

PROPELLING MACHINERY.

The propelling machinery consists of seven Parsons steam turbines, operating three shafts. The center shaft is driven by the main high-pressure turbine, and the two wing shafts are each driven by one low-pressure turbine, which, within the same casing, also contains a backing turbine. Forward of each low-pressure turbine, and connected to the rotor shaft by a flexible coupling, are the high-pressure and intermediate-pressure cruising turbines. The wing shafts turn outboard when

going ahead and the center shaft turns in the same direction as the starboard wing turbine. All of the turbines, together with the auxiliary machinery, are placed in one compartment. The turbine operating valves, together with steam strainer and the stop valves to the main steam lines from the boilers, are placed on the forward engine-room bulkhead.

The condensers are cylindrical with packed tubes, the circulating water being furnished by independent circulating pumps. There are two double vertical, single-acting air pumps and auxiliary condenser with combined air and circulating pumps. Two main feed pumps are placed aft near the feed tank. In the engine room are placed, also, two evaporators and one distiller, a feed heater, two 6-kilowatt turbine-driven dynamos, two lubricating oil pumps with oil cooler and oil cooler circulating pumps and a fire and bilge pump.

BOILERS.

There are four Thornycroft (new type) watertube boilers, with tube ends submerged under the water level of the steam drum. The boilers are placed in two compartments, fore and aft, with one fire room in each. The oil fuel tanks are located forward of the forward boiler compartment, and the oil-settling tank abreast of the boilers. The oil burners are of the Thornycroft type, and consist of eleven oil sprayers, the oil being sprayed by mechanical atomization without the use of either steam or compressed air jets. The air required for combustion of the fuel is supplied to each boiler room by two turbine-driven Sirocco forced-draft blowers. The oil-burning arrangement is in all essential details similar to that described in a general way in an article—"Modern Torpedo Destroyers"—which appeared in the August number of International Marine Engineering.

Each boiler has about 4,500 square feet of tube heating surface with 460 cubic feet of furnace space. Each oil heater has about 67 square feet of heating surface. The vessel has three smokestacks, of which the center stack takes the gases of combustion from the two middle boilers.

PROPELLERS AND SHAFTING.

The diameter of rotor shaft journals is 7 to 9 inches, and the line shafting is 6¾ inches outside diameter, with a 3½-inch inside diameter. The propellers are made of Monel metal, with blades and hub in one piece. The diameter is 5 feet 3 inches, and the pitch is 4 feet 10 inches, with a total projected blade area of 13 square feet.

TRIAL DATA.

The standardization trials were made on a course off the Delaware Breakwater, on July 12 and 13 last, and the official speed trials on July 14, 15 and 16, on a course off the Virginia Capes.

On the four-hour full speed trial the maximum speed of 29.7 knots was attained on a mean displacement of 711 tons.

Mean revolutions of turbines = 795.

Pressure in boiler = 239 pounds gage.

Pressure in main high-pressure turbine = 217 pounds abs.

Pressure in high-pressure cruising turbine = 2.5 pounds abs.

Pressure in intermediate-pressure cruising turbine = 5.0 pounds abs.

Pressure in low-pressure main turbine = 49.6 pounds abs.

Vacuum = 27.5 inches, with 30 inches barometer.

Pressure in fire rooms = 3¼ inches.

Horsepower, main turbines, = 11,790.

Water per hour per shaft horsepower of main turbines = 16.92 pounds.

Horsepower of auxiliaries = 500, about.

Nautical miles per ton of fuel (2,240 pounds) = 4.43.

Pounds of fuel oil per hour = 14,937.

British thermal units per pound fuel oil = 19,388.

Slip of propellers, mean, = 22 percent.

Pounds of water evaporated per pound of oil = 13.358.

On the twelve-hour 16-knot trial the following data were obtained:

Revolutions per minute all turbines, 380.

Pressures in main high-pressure turbine steam belt, 27.2 pounds abs.

High-pressure cruising turbine steam belt, 211 pounds abs.

Intermediate-pressure cruising turbine steam belt, 62 pounds abs.

Low-pressure main turbine steam belt, 10.3 pounds abs.

Vacuum (barometer 30.2), 29.3 inches.

Shaft horsepower, all turbines, 1,490.

Horsepower auxiliaries, 140.

Water consumption per shaft horsepower-hour turbines, 25.61 pounds.

Pounds water per pound of fuel oil = 12.00.

Nautical miles run per ton of fuel oil, 11.37.

Slip of propellers, mean, 10.5 percent.

Speed, average on run, 16.85 knots.

On the twelve-hour 25-knot trial the following data were obtained:

Revolutions per minute, all turbines, 646.

Pressure in main high-pressure turbine, 115.7 pounds abs.

High-pressure cruising turbine, 2.53 pounds abs.

Intermediate-pressure cruising turbine, 260.8 pounds abs.

Low-pressure main turbine, 8.11.

Vacuum (barometer 30.12), 29.35

Shaft horsepower, all turbines, 7,122.

Horsepower auxiliaries, 255.

Water consumption per shaft horsepower of turbines per hour, 16.31 pounds.

Water evaporated per pound of fuel oil = 13. pounds.

Nautical miles run per ton of fuel oil, 6.38.

Slip of propellers, 17.2 percent.

Speed, average on run, 25.5 knots.

The Mordenwood.

Messrs. Ropner & Sons, Ltd., Stockton-on-Tees, have recently built a steel screw steamer of the following dimensions:

Length	342 feet 3 inches
Breadth	47 feet
Depth	24 feet 9 inches

The vessel is classed 100 A1 at Lloyds, having main deck, poop, bridge and T. C. forecastle. Accommodation for the captain, officers and engineers is in houses on the bridge deck, and for the crew in the forecastle.

The vessel has double bottom on the cellular principle for water ballast. She is fully equipped with an up-to-date outfit, including quick-warping steam windlass, stockless anchors, steam-steering gear amidships, and powerful screw gear aft. The appliances for loading and discharging cargoes expeditiously are very complete, and include six steam winches, steam being supplied by a large donkey boiler. The holds are entirely clear of obstructions to stowage of cargo, having center line pillars only. This is a construction which has been found to give the best service in a cargo steamer of this size and type.

The engines are of the triple-expansion type by Messrs. Blair & Company, Ltd., Stockton-on-Tees, of about 1,300 indicated horsepower. Steam is supplied by two steel boilers, 15 feet 3 inches by 10 feet 3 inches, working at 160 pounds steam pressure.

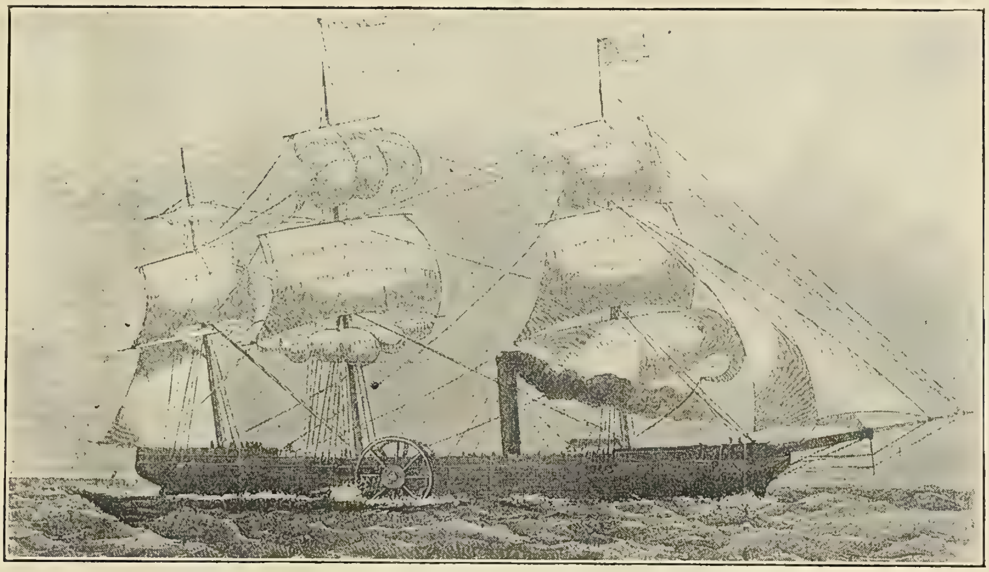
The vessel has been built to the order of Messrs. Constantine & Pickering Steamship Company, Middlesbrough, and has been named *Mordenwood.*

OLD AMERICAN TRANSATLANTIC STEAM LINERS.

BY FRANCIS B. C. BRADLEE.

In the following article we shall confine ourselves to a sketch of the early attempts at transatlantic steam navigation, to be followed by an account of the various lines started at one time or another by Americans. Into the general history of transatlantic steam navigation we shall not enter; such would be impossible in the limits of one article.

To the present generation the old-time side-wheel steamers are little more than names, and yet, in their day, they were ships of great size, great power and considerable speed. They were indeed ships which did much credit to their builders and owners. John Fitch, who built at Philadelphia in 1787 the first steamer worthy of the name, while praising his hobby to visitors, made use of the following words: "This, gentlemen, whether I bring it to perfection or not, will be the mode of crossing the Atlantic in time for packets and armed vessels." After which, one visitor said to the other, "Poor fellow, what a pity he is crazy!"



THE SAVANNAH, FIRST STEAMSHIP TO CROSS THE ATLANTIC OCEAN (1819).

Robert Fulton, who first made a commercial success of steam navigation with his *Clermont* on the Hudson in 1807, is said to have built a steamer called the *Emperor Alexander*, which he intended to send across the Atlantic and sell to the Russian Government, but the breaking out of the War of 1812 frustrated his design. To Robert Fulton, however, is due the credit of having designed and built for the United States navy in 1814 the first war steamer in the world, a huge floating battery called the *Demologos*. She measured 2,475 tons and steamed 5½ miles an hour against the tide on the only sea trip she made, which was from New York to Sandy Hook and return in July, 1815. Had the *Demologos* only been finished a year sooner she might have changed the world's method of naval warfare, as the *Monitor* and *Merrimac* did fifty years later.

The first steam vessel to cross the Atlantic was the *Savannah*, built in 1818 at Corlears Hook, in the city of New York, by Crocker & Fickett. The *Savannah* was a ship-rigged side-wheel vessel of 380 tons, 130 feet long, 26 feet beam and 16½ feet depth of hold. Her 90 (indicated) horsepower, low-pressure engine, of the inclined, direct-acting single cylinder type, was built by James P. Allaire of New York, and cost about $3,500 (£720). The cylinder was 40 inches in diameter, with a 5-foot stroke, giving her a speed of about 5 knots under steam alone. The engine was in the 'tween decks and the boilers in the lower hold. Her coal consumption was about 9 tons per day, and on her passage to England she carried 75 tons of coal and 25 cords of wood. No passengers or cargo were carried on this voyage. Her paddle wheels were not boxed in and were so arranged that they could be easily detached from the shaft and taken in on deck in rough weather.

This memorable voyage of the *Savannah* from America to England was begun May 24, 1819, when she sailed from New York to Savannah. From Savannah she proceeded direct to Liverpool, where she arrived after a passage of eighteen days, during seven of which she was under steam. Her arrival in England caused much excitement, and she was visited by great numbers of people, including many persons of distinction. As she had been built with the sole idea of selling her to the Emperor of Russia, she soon departed to Elsinore, on her way to St. Petersburg. On the voyage she touched at Copenhagen and Cronstadt, and was visited by the King of Denmark, the Emperor of Russia and other noted persons. She was not sold, however, as had been expected, and sailed for home, arriving at Savannah after a voyage of 22 days. On account of the high price of fuel she carried no steam on her return passage, and the wheels were taken off. At the completion of the voyage the *Savannah* was purchased by Capt. Nathaniel Holdrege, and in 1820 was divested of her engine, which was bought by James P. Allaire, its builder. She was subsequently used as a sailing packet between Savannah and New York, and went ashore on Long Island and broke up in 1821.

Capt. Moses Rodgers, the commander of the *Savannah*, died in the forties on the Pee Dee river, North Carolina. He is believed to have been the first man that ran a steamboat either to Philadelphia or Baltimore.

Relative to the disputed claim of Americans to the honor of sending the first steamer across the Atlantic, an English newspaper, at the time of the arrival in New York of the steamship *Sirius* in 1838, printed the following: "The practicability of the undertaking (navigating the ocean by steam) was, in fact, already proved by American skill; the question now to be settled is its economy and its superiority to the usual mode of navigating; and this, we admit, will be due to British enterprise."

John Kennedy, in his History of Steam Navigation, Liverpool, 1903, says: "On the 5th of October, 1820, the steamer

Conde de Patmella, Capt. Silva, sailed from Liverpool for the Brazils. She made a remarkably rapid passage to Lisbon, arriving there in four days. This is probably the first steamer that ever crossed the Atlantic Ocean from England."

In 1825, the steamer *Enterprize* made the voyage from London to Calcutta. She left on August 16, under the command of Lieut. Johnston, R. N., with 17 passengers, and arrived on December 7 following, thus making the passage in 113 days, during 64 of which she was under steam. The *Enterprize* was a wooden paddle-wheel steamer, built of wood by Messrs. Gordon & Company, Deptford, at a cost of $210,000 (£43,000). Her length was 122 feet, beam 27 feet and she registered 479 tons. She had a copper boiler in one piece which weighed 32 tons and cost $34,000 (£7,000). Her engines were 120 horsepower (nominal), and were capable of propelling her at the rate of 5 knots in smooth water. The *Enterprize* was sold to the East India Company soon after her arrival at Calcutta, and used by them as a transport and despatch vessel.

Arthur J. Maginnis, in the "Atlantic Ferry," London, 1900, says that a Dutch steamer, called the *Curacoa,* of 350 tons, 100 horsepower, built at Glasgow, made several voyages between Antwerp and Curacoa in 1829.

The facts about the voyages of the *Conde de Patmella* and *Curacoa* have been much disputed and by some people these two ships have been called myths, but the facts are here given for what they are worth.

In 1820, a ship-rigged vessel of 750 tons, called the *Robert Fulton,* fitted with a "cross-head" engine (similar to those on the early Long Island Sound steamers), was put on the route between New York and New Orleans, stopping on the way at Charleston and Havana. The *Robert Fulton* had two boilers and two funnels, and was very successful as an ocean-going steamer, but not so much so financially, so that she was sold to the Brazilian Government in 1823; her engine was taken out and she was used as a cruiser and was afloat as late as 1838.

In 1830, the *Meteor,* a British steamer, ran regularly as a mail packet between England and the Mediterranean.

As early as 1828, the Valentia Steam Navigation Company was incorporated by Act of Parliament, to establish steam communication between the West of Ireland and America. According to an old circular, the company's first steamer was estimated to cost $103,000 (£21,000). She was to be about 800 tons, driven by engines of 200 horsepower (nominal), and


THE ROYAL WILLIAM, FIRST VESSEL TO STEAM ALL THE WAY ACROSS THE ATLANTIC (1833).


THE GREAT WESTERN (1838), THE FIRST STEAMSHIP TO MAKE REGULAR PASSAGES ACROSS THE ATLANTIC.

was expected to make at least six round voyages per annum. There were to be accommodations for 50 cabin and 50 steerage passengers, and 200 tons of freight, exclusive of coal. As nothing more can be learned about this company, it is probable that the whole scheme fell through for want of support.

The first vessel to steam the whole way across the Atlantic was undoubtedly the *Royal William* (first of the name). As many mistakes are made concerning this steamer, some authors confusing her with the *Royal William No. II,* an entirely different ship, that made several voyages between Liverpool and New York in 1838-39, the following account, condensed from a paper read before the Quebec Historic Society in 1894, is believed to be absolutely correct.

The *Royal William* was built of wood at Quebec in 1831, by James Goudie, for the Quebec & Halifax Steam Navigation Company, to run between those two ports. She was 830 tons gross, 176 feet long, 29 feet beam and 17.9 feet depth of hold, and her side-lever engines of 200 horsepower (nominal) were made in England by Boulton & Watt, and fitted in the ship at Montreal by Bennett & Henderson. Owing to the cholera epidemic of 1832 (and perhaps other reasons), the *Royal William* was not a success on the Quebec & Halifax route, and it was determined to send her to England to be sold. Accordingly she left Quebec for London, Aug. 4, 1833, under the command of Capt. John McDougall, and after coaling at Picton, N. S., and Cowes, arrived at London on September 11. She met with very heavy weather on the way, one of her paddle wheels being nearly disabled. In 1834, the *Royal William* was sold to the Spanish Government, made into a man of war, and armed with six guns. It is said she was the first war steamer to fire a gun in action. She was finally broken up, owing to dry rot, at Bordeaux in 1839, and her engine utilized elsewhere. In passing, it is interesting to note that one of the original owners of the *Royal William* was Samuel Cunard, of Halifax, N. S., who afterwards was one of the founders of the famous Cunard line, and it is thought that his interest in the *Royal William* first gave him the idea of starting a line of ocean steamers.

What has been called the real beginning of transatlantic voyages under steam were the first trips of the steamers *Sirius* and *Great Western,* about the facts and dates of which there has been quite a little confusion, and about which various publications differ. It is certain they were the first steamships to make regular trips across the Atlantic, and the facts here given are taken from the newspaper files of the date of their arrival in this country.

The *Great Western* was the larger and more powerful craft. She was owned by the Great Western Steamship Company, and was built of wood at Bristol in 1837 by William Patterson from designs by Isambard Kingdom Brunel, the famous engineer, who afterwards designed the *Great Eastern.* She was 1,340 tons gross, 679 tons net, 212 feet long, 35 feet beam, 23 feet depth of hold, and had four masts, with square yards on the foremast.

Being especially built for the transatlantic service, the *Great Western* was of unusual strength, her bottom being solid and her frame secured with iron diagonal bracing. Her motive power consisted of side-lever engines, built by Maudslay & Sons, of London, having two cylinders, each 73½ inches in diameter, 7 feet stroke; the paddle wheels were 28 feet in diameter, and steam was generated in four iron, return-flue boilers carrying a pressure of 12 pounds to the square inch, horsepower (nominal) 440, horsepower (indicated) 750, speed 8 knots. Her first commander was Lieut. James Hosken, R. N., and afterwards B. R. Matthews.

The *Great Western* left Bristol for New York on the 8th of April, 1838, with seven passengers on board, and arrived at New York on the 23d direct in 15 days. On the voyage out she had averaged 208 miles per day, her best day's run being 247 miles. She carried 600 tons of coal, of which she had consumed 400 tons. Her commander said the voyage had been made in almost a direct line across the Atlantic; that the weather had been good save for continual head winds. The passengers reported the ship's motion so slight on the way out that it was not necessary to put battens on the tables, and only once during the trip were teacups upset.

While the *Great Western* was fitting out at Bristol, a rival company, the British & American Steam Navigation Company (whose principal founder, Junius Smith, LL. D., an American, died in New York in 1853), chartered the steamship *Sirius* from the St. George's Steam Packet Company to make what may be called a voyage of announcement, pending the building of its own steamships, the *British Queen* and *President.*

The *Sirius* was a wooden paddle boat, built for the English-Irish cross-channel trade by Menzies & Company, of Leith, in 1836, and was 703 tons gross, 412 tons net, 178 feet long by 25½ feet broad, and 18 feet deep. The engines were of the side-lever type, built by Wingate & Company, Glasgow, having two cylinders, each 60 inches in diameter, 6 feet stroke; the steam pressure was 15 pounds to the square inch, horsepower (nominal) 320, (indicated) 600. In appearance the *Sirius* was long, straight, and low-lying in the water. She was equipped with distilling apparatus for providing fresh water for her boilers throughout her voyage, and it was said upon her arrival in this country that the distilling worm, or mass of copper pipes, was "four miles long." That statement was printed in the New York papers of that date.

The *Sirius* hauled out of the London docks, Mar. 28, 1838, under the command of Lieut. Richard Roberts, R. N., one of the ablest navigators of his day (in passing it is interesting to note the full list of officers of this pioneer liner: John Dudley, chief officer; G. T. Briggs, R. N., second officer; T. A. Whittaker, H. C. M., R. N., third officer; John Lambert, chief engineer; William Denning, second engineer), and proceeded to Cork Harbor to embark her passengers (40 in number), and at 10 A. M. on April 4, 1838, she sailed for New York. The *Sirius* arrived in New York at 10 o'clock Sunday evening, April 22, and the *Great Western* at 3 o'clock on the Monday afternoon following the arrival of the *Sirius.* Thus the *Sirius* made the voyage in 18 days and the *Great Western,* as before stated, in 15 days. The passengers on the *Sirius* said they delighted with her qualities as a seaboat. As the steamship on nearing New York failed to find a pilot, she ran in without one and grounded off the Hook, but floated again, uninjured, upon the rising tide. Her average speed on the voyage was 161 miles per day, her maximum run being 220 miles, and her minimum run 85 miles. She consumed 450 tons of coal, and ran short before reaching her destination, burning spare spars, resin, etc.

The *Great Western* ran regularly between Bristol, and later Liverpool and New York, until 1847, when she was sold to the West India Royal Mail Steam Packet Company. Her best time, while on the New York route, was 12 days 7 hours from New York to Liverpool. She was finally broken up at London in 1857. The *Great Western* was always a great favorite with passengers, often carrying over 100 cabin passengers (no steerage were taken at this time by the steamers).

The *Sirius* made a second voyage between Cork and New York in June, 1838, under the command of Capt. Stephen Sayer Mowle, and her engineer then reported "that they had not stopped the engines from port to port." At the conclusion of this voyage, being too small for the transatlantic trade, she returned to the English-Irish cross-channel route, and was totally wrecked near Queenstown in January, 1847. In 1899 the main shaft of her engine was at work driving a mill a few miles outside of Cork.

From April, 1838, may be said to date regular transatlantic

steam communication. In April, 1838, the British steamer *City of Kingston* went from Cork to the West Indies, and thence to New York via Baltimore and Norfolk. In speaking of her the London *Times* said: "We shall be curious to learn what effect the climate of the West Indies will have on her engines and boilers."

Owing to the success of the *Great Western* and *Sirius*, the Liverpool Transatlantic Steamship Company was formed by several Liverpool merchants; and it is curious to note that at that early period, before any of the steamers were under a mail contract, it was suggested by the above company that three lines, then in the transatlantic service, should come to an agreement regarding the sailings of their vessels, so as to insure a weekly steam communication with the United States.

The Liverpool Company chartered the *Royal William* (second of the name) from the City of Dublin Steam Packet Company to begin their service. She was a wooden paddle steamer, built in 1836, of 817 tons gross, 175 feet long, with side-lever engines of 400 indicated horsepower. The *Royal William II* was the first transatlantic steamer to have water-tight bulkheads, of which there were four iron ones. She made quite a number of voyages between Liverpool and New York in 1838-39, which averaged 19 days going to the westward and 14½ days to the eastward.

THE PRESIDENT, FIRST TRANSATLANTIC LINER LOST AT SEA (1840).

In October, 1838, the *Liverpool*, a wooden side-wheel steamer of 1,150 tons, 235 feet long, 35 feet beam and 21 feet depth of hold, with side-lever engines having two cylinders, each 75 inches in diameter, 7 feet stroke, especially built for the service by Messrs. Humble & Milcrest, came on the line, but was not a success, being slow and cranky. She plied with more or less regularity until the early part of 1840, when she was sold to the Peninsular & Oriental Company, and lengthened and renamed the *Great Liverpool*. She was totally wrecked off Cape Finisterre on February 24, 1846.

The Liverpool Transatlantic Company also had built by W. and J. Wilson, Liverpool, as a mate to the *Liverpool* a fine, large wooden paddle boat called the *United States*. She was 1,787 tons gross, 235 feet long, with side-lever engines of 420 horsepower nominal, and at the time of her launch on March 7, 1840, was the largest vessel that had ever been built at Liverpool. As far as can be traced, however, from careful searching of old newspaper files, the *United States* never made a trip on the line, but was sold before completion to the P. & O. Company, owing to the financial embarrassment of her owners.

On July 12, 1839, the *British Queen*, the new ship of the British & American Company, sailed from Portsmouth (England) on her first voyage to New York under the command of Lieut. Roberts. She was followed by the *President*, which sailed from Liverpool on her first voyage Aug. 1, 1840, commanded by Lieut. R. J. Fayrer, R. N. Both these vessels looked much like the old-fashioned steam frigates, as they were very high out of water, were heavily rigged, and had long rows of square ports. They are described as being "exactly alike," but the *President* was 2,360 gross (at that time the largest ship in the world), 268 feet long, equipped with side-lever engines by Faucett & Preston, of Liverpool, with 2 cylinders, each 81 inches in diameter, 7½ feet stroke, horsepower (nominal) 540, and indicated about 800, and the *British Queen* (both vessels were built by Curling & Young, on the Thames, and were, of course, wooden side wheelers) was 1,863 tons gross, 275 feet long, 37½ feet beam and 27 feet depth, side-lever engines by R. Napier, Glasgow, having 2 cylinders, each 71½ inches in diameter, 7 feet stroke, 500 horsepower (nominal), and 700 indicated. The interior fittings of both vessels were very luxurious for those days, but from the point of view of speed they were rather a failure (probably from lack of power), especially the *President*. The *British Queen's* best passage was 13 days 11 hours from New York to Portsmouth in August, 1840, and the *President's* best time was 14 days 12 hours from New York to Liverpool, September, 1840.

The *President* was the first transatlantic steamer lost; she left New York for Liverpool on Mar. 11, 1841, commanded by Lieut. Richard Roberts, with 136 souls on board (among her passengers were Tyrone Power the actor and a son of the Duke of Richmond), and was never heard of again. The last seen of her was on the evening of March 12, by Capt. Cole, of the packet ship *Orpheus*, also bound to Liverpool. The *President* was then laboring and pitching heavily in a tremendous sea, and, in the opinion of the captain of the *Orpheus*, she went down that night with all on board. This was quite likely to have been the case, as grave doubts had some time before been expressed as to the *President's* strength owing to her then extreme length.

The disaster to the *President* caused immense excitement on both sides of the Atlantic, and as no cable was then working, rumors of her safety prevailed as late as June, 1841. Owing to the loss of the *President*, and also to the competition of the subsidized Cunard steamers, the British & American Company came to an end in 1841, and the *British Queen* was sold to the Belgian Government.

Regarding the talk so often made later during the war between the Collins and Cunard lines, that no line of mail steamers could exist without a Government subsidy, the following statement, quoted from the "American Review" for January, 1845, regarding the early steamers just mentioned and the Cunarders is interesting: "We have before us the prospectus of the British & American Steam Navigation Company, got up by Junius Smith, Esq., of New York. In that document we find a detailed account of the profits and losses of the *British Queen* and *President*, the authenticity and correctness of which may be relied on. From this account it appears that these ships never failed to net for their owners some profit until the operations of the Cunard line began, and from that time till the dissolution of the company all profit ceased and every voyage only added to the loss. This fact pretty clearly indicated the chief cause of the failure of the New York lines of steamships."

In October, 1838, the English Government advertised for tenders to carry the mail by steam to the United States *via* Halifax, N. S., the service to be fortnightly in summer and monthly in winter. The Great Western Company tendered, but were much surprised and chagrined when their offer was refused and the one made by Samuel Cunard, of Halifax, N. S., George Burns, of Glasgow, and David McIver, of Liverpool, calling themselves the British & North American Mail Steam Packet Company (later the Cunard line), was accepted. Their tender provided for a service as above, with a branch

line from Halifax to Quebec, to be performed by four steamers of 1,200 tons each, with engines of 400 horsepower (nominal). The compensation or subsidy was $292,000 (£60,000) per annum, soon afterwards raised to $394,000 (£81,000) per annum, and the ships were to be sufficiently strong to enable them to be transformed into men-of-war in case of need.

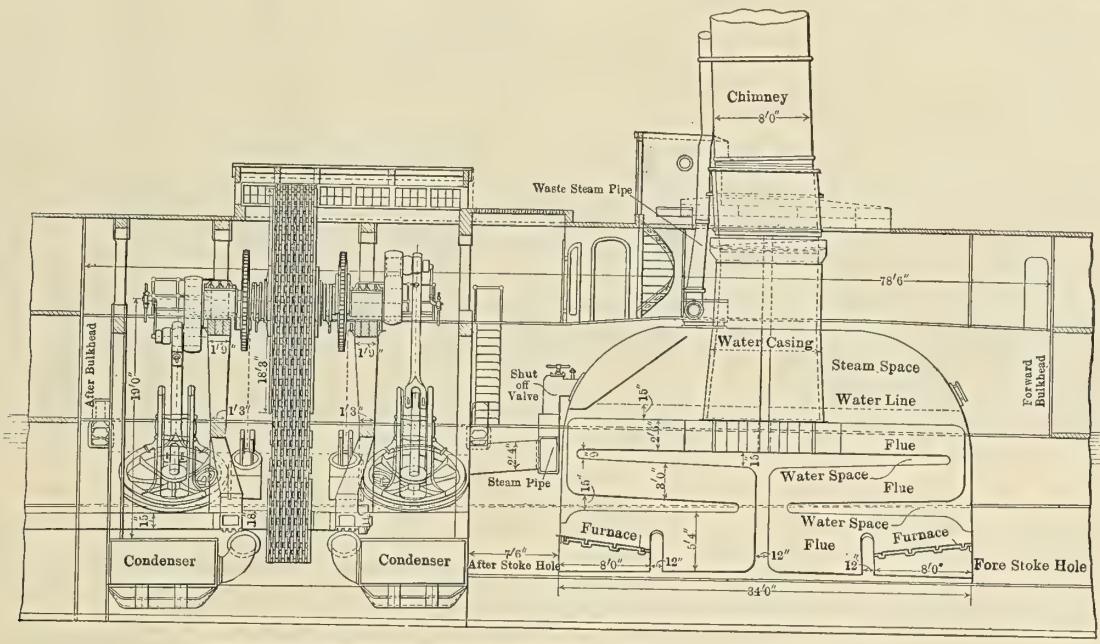
The first four steamers of the Cunard line have been so often written up and described that it will suffice to say here that they were the wooden paddle steamers *Britannia, Acadia, Caledonia* and *Columbia,* all alike, built on the Clyde, 1,150 tons gross, 207 feet long, 34 feet beam with side-lever engines of 740 indicated horsepower; the speed was about 8 knots, and the coal consumption 38 tons per day. On each ship there was accommodation for 90 passengers and 225 tons of cargo. Contrary to general belief, the steamship *Unicorn* was the first of the Cunard fleet to cross the ocean. She was of 649 tons, 570 indicated horsepower (built in 1835 for Messrs. G. and J. Burns' Glasgow & Liverpool service), and was commanded by Lieut. Walter Douglas, R. N., it being the custom of the times to have naval officers in command of the mail steamers, although this practice was soon abandoned by the Cunard Company. She arrived in Boston, June 2, 1840, with 51 passengers.

The Cunard Company was compelled, as already stated, to have its steamers met at Halifax by another, which was to carry the mail to Quebec (this arrangement was discontinued in 1846), and so they sent the *Unicorn* over in advance of their regular boats to take up this Halifax-Quebec service, and having landed her passengers at Boston she returned to Halifax to meet the outward steamer from England.

The first regular steamer of the Cunard line was the *Britannia,* which sailed from Liverpool, July 4, 1840, and she was really the beginning of that wonderful service that has been conducted with unexampled regularity and safety from that day to this. Until 1848, the Cunard boats ran to Halifax and Boston only, but in that year a service was begun to New York, and up to 1868 the steamers ran alternately to Halifax and Boston and New York, but after that the mail steamers all ran to and from New York.

After the rejection by the British Government in 1838 of their tender for the mail service, the Great Western Steamship Company were naturally much chagrined, but they determined to build at once another steamer (as a companion to the *Great Western*) that should surpass anything afloat. This was the *Great Britain,* celebrated as the first iron and the first screw ocean steamer. She was designed (as was the *Great Western*) by Isambard K. Brunel, and built by William Patterson at Bristol. She was originally intended as a paddle-wheel vessel, but was changed while building to a screw, and it is interesting to note that the Great Western Company had to undertake the construction of the screw engines themselves, as no private firm could, at that time (1841), be found

THE GREAT BRITAIN, THE FIRST IRON AND FIRST SCREW OCEAN STEAMER (1845).



LONGITUDINAL SECTION OF THE ENGINES AND BOILERS OF THE GREAT BRITAIN.

who would be willing to build propeller engines of 1,500 indicated horsepower.

The following details of the *Great Britain* are extracted from the "Life of Brunnel." "Total length, 322 feet, length of keel, 289 feet; beam, 51 feet; depth, 32½ feet; draft of water, 16 feet; gross tonnage, 2,984; number of cylinders, 4; diameter of cylinders, 88 inches; length of stroke, 6 feet; weight of engines, 340 tons; weight of boilers, 200 tons; weight of screw shaft, 38 tons; diameter of screw, 15 feet 6 inches; pitch of screw, 25 feet; weight of screw, 4 tons.

"A balanced rudder was a part of her original construction, and the unusual method of lapping the plates will be noticed. Apart from their size, the design of the engines of the *Great Britain* necessarily presented many peculiarities. The boilers, which were six in number, were placed touching each other, so as to form one large boiler, about 33 feet square, divided by one transverse and two longitudinal partitions. It would seem that the boiler was worked with a pressure of about 8 pounds.

"The main shaft of the engine had a crank at either end of it and was made hollow, a stream of water being kept running through it, so as to prevent heating in the bearings. An important part in the design was the method by which motion was transmitted from the engine to the screw shaft, for the screw was arranged to go three revolutions to each revolution of the engines. Where the engines do not drive the screw directly, this is now universally effected by means of toothed gearing, but when the engines of the *Great Britain* were made it was thought that this method would be too jarring and noisy. After much consideration chains were used, working round different sized drums with notches in them, into which fitted projections on the chains."

On July 19, 1843, the *Great Britain* was launched, being christened by H. R. H. Prince Albert, but it was not until Jan. 23, 1845, that she left Bristol for London, making on her voyage an average of 12 1/3 knots. She left Liverpool for New York on August 26, and arrived on September 10, having made the passage out in 14 days 21 hours; she returned in 15½ days, and during the passage home her highest daily run under steam and sail was 331 nautical miles. During the next winter, after one more voyage to New York, alterations were made to give a better supply of steam, and a new screw was fitted. The *Great Britain* made two voyages to New York in 1846, and on September 22 she left Liverpool on a third, but overran her reckoning and stranded in Dundrum Bay, on the northeast coast of Ireland, when it was supposed she was only rounding the Isle of Man.

This unfortunate event completed the ruin of the Great Western Company, which was already in financial straits through the competition of the Cunard line; and the ship, after her rescue, effected Aug. 27, 1847, almost a year after grounding, was sold to Messrs. Gibbs, Bright & Company, of Liverpool, by whom she was repaired and fitted with new auxiliary engines of 500 nominal horsepower. On a general survey being made it was found that she had not suffered any alteration of form, nor was she at all strained. She was taken out of dock in October, 1851, and after a trial trip to New York and back in May, 1852 (making the passage to England in 10 days 23 hours), she was employed regularly between Liverpool and Australia until 1882, when, being unable to compete with the new class of steamers, the *Great Britain* was sold to Messrs. Anthony Gibbs, Sons & Company, who removed the engines and transformed her into a full-rigged sailing ship. She was used as such until 1886, when she put into the Falkland Islands in a leaking condition, was condemned, and is (or was until quite lately) used as a coal hulk there.

(*To be continued.*)

FIG. 1.—NEW 16-KNOT PORTUGUESE MAIL STEAMER LISBOA.

THE PORTUGUESE ROYAL MAIL STEAMER LISBOA.

The twin screw passenger and mail steamer *Lisboa* was built by Messrs. David and William Henderson & Co., Ltd., at Meadowside, Glasgow, to the order of the Empreza Nacional de Navegacao a Vapor, of Lisbon. The dimensions of the vessel are: Length over all, 452 feet; breadth, 54 feet; depth molded to shelter deck, 37 feet 6 inches, with a gross tonnage of about 7,200. The vessel has been specially designed for the owners' passenger and mail service between Portugal and the Portuguese possessions in Africa, and is fitted with accommodation for first, second and third-class passengers. She is built to class 100 A1 in Lloyd's Registry, and will be one of the largest and most up-to-date vessels flying the Portuguese flag.

The first-class accommodation is fitted amidships, and is of an extremely comfortable and artistic design, with everything

that can add to the comfort of the passengers. It consists of a large dining saloon, drawing room and smoke room, all ventil- and staterooms. Forward on the upper deck is accommodation for 142 third-class passengers, and on the same deck aft ar-

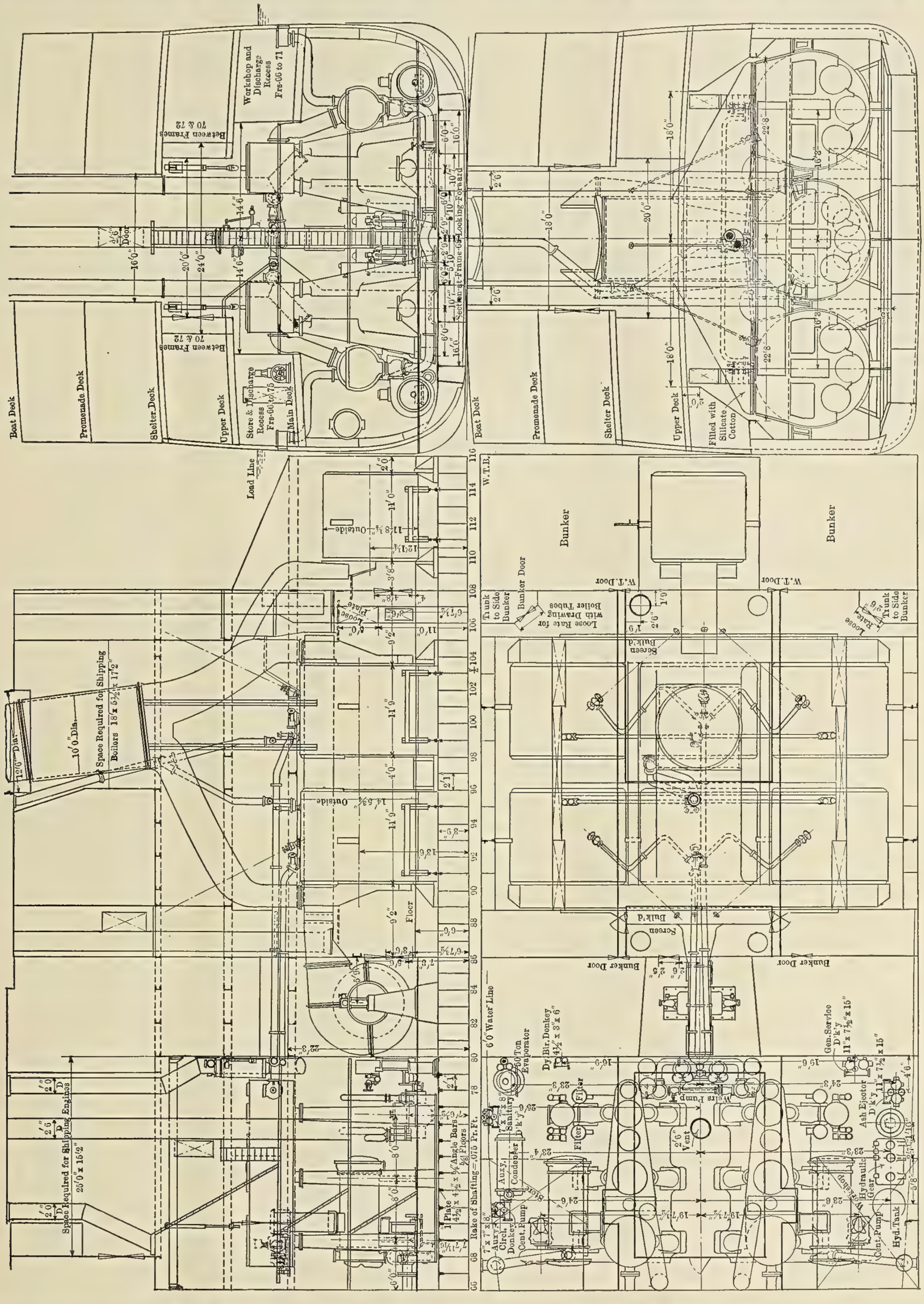


FIG. 2.—SECTIONS THROUGH MACHINERY SPACE OF THE LISBOA, SHOWING LOCATION OF MAIN AND AUXILIARY MACHINERY.

ated and lighted by large dome skylights and square windows. The second-class passengers are placed aft, and they also have been well provided for in the way of comfortable public rooms rangements have been made for carrying 100 steerage passengers.

The main engines are two sets of triple expansion engines,

each set having cylinders 25, 41 and 67½ inches diameter, respectively, with a piston stroke of 48 inches, and together with the whole of the machinery they are made to pass the British Board of Trade and Lloyds Registry for a working steam pressure of 190 pounds per square inch, and are fitted with all the latest improvements for securing economy.

The boilers are six in number, 14 feet 3 inches diameter, and 11 feet 9 inches long, and worked with forced draft on Howden's system with all their latest improvements. The furnaces are fitted with Sturrock's Patent Bridges. Heating surface, 13,302 square feet; grate area, 330 square feet. Large condensing surface is provided for tropical climates, and an ample supply of water is insured by an extra large centrifugal circulating pump provided for each condenser, each pump being large enough to supply all the water required for both condensers, which will minimize the risk and delay should either pump break down. The boilers are fed by a pair of G. & J. Weir's pumps and direct contact heater, the feed pumps of the main engines delivering the water to the heater. In addition a large independent duplex pump with gunmetal pump end is provided for feeding boilers and general purposes; a similar pump is also supplied with the same connections as the

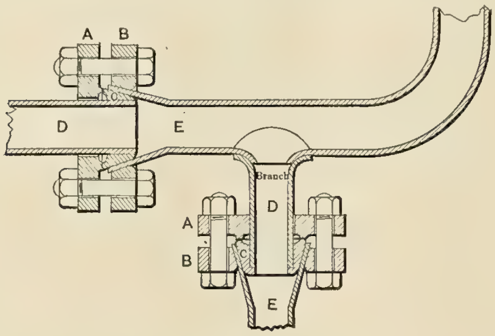


FIG. 3.

feed pump, which insures an ample supply of feed water to the boilers at all times. These duplex pumps are also connected to two See's patent ash ejectors.

A steam ash hoist, by Shanks, of Arbroath, is also fitted. The other auxiliary machinery provided is a large ballast pump, steam reversing gear, steam turning gear, large fan and two engines for forced draft, a duplex pump for feeding the donkey boiler, which has a regulating float tank in connection with it, and a fresh water pump for deck purposes. Two large gunmetal sanitary pumps are driven by the main engines for sea use, and for port use a large duplex pump is provided. There is also an evaporator of the latest type, with connections for use both at sea and in port. Suction filters are provided on each feed pump of the builders' usual design. Beside ample store room accommodation, a workshop is fitted with lathe and drilling machine driven by an electric motor.

The main steam and main feed pipes are of copper fitted with "Geddes" flanges, and a considerable number of Bryce's patent pipe couplings are fitted throughout the vessel. Ample surfaces are provided for all working parts, as the engines are run at high speed. The propellers have four loose blades of bronze fitted to cast iron bosses. A large donkey boiler is provided working at the same pressure as the main boilers, and reducing valves are supplied where necessary for the auxiliaries which require lower pressure than is maintained in the boiler. This boiler provides steam for the engine room auxiliaries and deck cranes and winches, also for the refrigerating machinery and three electric lighting sets.

The deck machinery consists of nine of the builders' own specially strong winches, with 7-inch cylinders and 12-inch stroke, and one with 8-inch cylinders and 12-inch stroke aft, with extended ends and barrels inside the wheelhouse to work relieving tackles for steering in case of need. In addition to these there are four of Messrs. Brown Bros. hydraulic cranes fitted, driven by a set of three crank pumping engines and accumulator situated in the engine room. These engines are of ample power to work all four cranes at one time.

All of the machinery has been specially designed to render the heat of the tropical climates as little harmful as possible to those working in the machinery space, for which purpose a well-designed ventilation scheme is provided, and all parts liable to radiate heat are thoroughly lagged with non-conducting material.

A notable feature in the equipment of this vessel is the adoption of Bryce's improved coupling for copper pipes. From the sketch (Fig. 3) it will be seen that the end of one length of pipe E is bellmouthed and is drawn up on a brass conical ferrule C brazed on the other, and held by flanges A and B fitted loose on the pipes, the flanges being preferably of mild steel stamp forgings, one flange only being machined to the taper required. The copper pipe being closely drawn up between the two harder materials makes a good metallic joint not liable to leak in any way without jointing medium of any kind.

The *Lisboa's* dining saloon is in fumed oak, parquetry flooring, with Wilton carpet runners; the chairs are upholstered in light green Morocco leather. The music saloon is in white Georgian style, upholstered in rose pink tapestry; the floor is covered with india rubber tiling. The smoking room is in waxed walnut, upholstered in brown morocco; floor covered with india rubber tiles. The auxiliary or children's saloon is in white, with fumed oak furniture and light green Morocco upholstery.

The staterooms are upholstered in olive green morocco; the floors are of patent "Keylock" parquetry. The entrance halls and vestibules are of polished teak, with green morocco seats and floor covered with india rubber tiles.

The second-class dining saloon and smoke room are in fumed oak, upholstered in light grey haircloth. A special feature of all the passenger accommodation is the size of the cabins and the width of the alleyways.

During construction the vessel was under the supervision of Mr. T. C. Laws, Liverpool, the owners' representative in this country, and also of Mr. J. A. Edwards, the company's superintendent from Lisbon.

The *Lisboa* ran trials on the measured mile on the Firth, of Clyde attaining a mean speed of 16½ knots, which is one knot more than that stipulated in the contract. She ran a six hours' trial at full speed, and also went through steering and other trials and cruised for a short time in the Firth.

The *Lisboa* will spend practically 90 percent of her time about the equator and to make her thoroughly comfortable, for her passengers required a great deal of consideration. The owners have taken great care that she should give the maximum of comfort even in the warmest weather, and there has been no stinting of space.

The statistical summary of vessels totally lost, broken up, condemned, etc., now published by *Lloyd's Register,* shows that during 1909 the gross reduction in the effective mercantile marine of the world amounted to 866 vessels of 939,232 tons, excluding all vessels of less than 100 tons. Of this total 383 vessels of 645,670 tons were steamers and 483 of 293,562 tons were sailing vessels. These figures exceed those of 1908 by 12,940 tons. This excess is not due to actual casualties, the figures for which show a diminution of 31,471 tons, but entirely to the unusual number of vessels which have been broken up, dismantled, etc. According to the statistics, strandings and kindred casualties, which are comprised under the term "wrecked," are much the most prolific cause of disaster. To such casualties are attributable 53.5 percent of the losses of steamers and 57.5 percent of sailing vessels.

A SINGLE-SCREW TUG AND PASSENGER TENDER.

The single-screw tug, *Flying Kestrel*, has recently been constructed by J. T. Eltringham & Company, of South Shields, for the Alexandra Towing Company, Ltd., of Liverpool. This vessel is of more than ordinary interest, in as much as she is not only one of the most powerful tugs yet built, but she is so designed that when not employed in ocean towing she may be used on the Mersey as a tender for Atlantic liners, and when thus engaged carries 715 passengers with their luggage.

The *Flying Kestrel* is 125 feet in length between perpendiculars, 28 feet 6 inches breadth, molded, and has a depth of 14 feet 9 inches, and is of 390 gross tonnage. She has a straight stem and elliptical stern, flush main deck, sheathed with pitch pine, a 'midship deckhouse, with promenade deck on top about 116 feet long, extending from the stern and leaving a well deck forward. A bridge deck overhead extends from the mast to abaft the coaling hatch.

THE FLYING KESTREL, A NEW SINGLE-SCREW TUG AND PASSENGER TENDER FOR SERVICE ON THE MERSEY.

The first class passenger saloon is on the main deck forward of the boiler space, and extends from side to side of the ship, with entrance from the steel deckhouse on the promenade deck. There is also a saloon under the main deck aft over the watertight flat of the shaft recess. There is a cross bunker between the engine and boiler space with coaling hatch abaft the funnel and side bunkers alongside of the boiler.

Accommodation for the officers and crew is under the forward saloon, with entrance from the port side. There is a separate apartment on the starboard side for the captain, and one on the port side for the engineer, with mess room in the center. The vessel has six watertight bulkheads, stiffened with angles. The main deck is sheathed with 5-inch by 3-inch pitch pine, and the promenade and bridge decks are laid with 4-inch by 2½-inch yellow pine.

The fore and aft peaks have deep floors and wash plates, and are constructed to form fresh water tanks, while the space between the top of the after tank and the main deck also forms a fresh water tank. A fresh water tank is constructed forward of the boiler bulkhead under the forecastle, which is divided into three sections, with deep floors and wash plates. The total capacity of the fresh water tanks is 140 tons, capable of being emptied in one hour.

The propelling machinery has been constructed by the Shields Engineering & Dry Dock Company, Ltd., of North Shields, and consists of a compound surface-condensing engine, 21 inches and 44 inches by 30 inches stroke. The boiler is 15 feet 9 inches by 10 feet 6 inches, and was built by Eltringham & Company for a working pressure of 120 pounds. An electrical installation has been provided by James Scott, Ltd., of Bootle, Liverpool. The engine and dynamo are placed on one bed at the after end of the starboard bunker in the engine room. The engine is an open-front, high-speed vertical steam engine of the double-acting type, with governor and special lubricating arrangement, while the dynamo is of the compound-wound continuous-current type.

The rudder is of the single-plate type. The stock is of the best forged iron, and the arms were shrunk on the main piece and provided with removable pintles. Donkin's steam steering gear is fitted, while the winch, windlass and steam capstans have been supplied by Clarke, Chapman & Company, Ltd., of Gateshead-on-Tyne.

The vessel has been built to Lloyd's special class 100 A-1, and has Board of Trade certificates Nos. 2, 3, 4 and 5.

The largest vessel of the French merchant marine has just been launched at St. Nazaire for the Compagnie Générale Transatlantique. This vessel, which was laid down April 20, 1909, is 722 feet over all, 76 feet beam, 52½ feet depth, with a displacement of 26,000 tons. She will be driven by turbine engines of 40,000 horsepower, designed to give her a speed of 23½ knots.

Obituary.

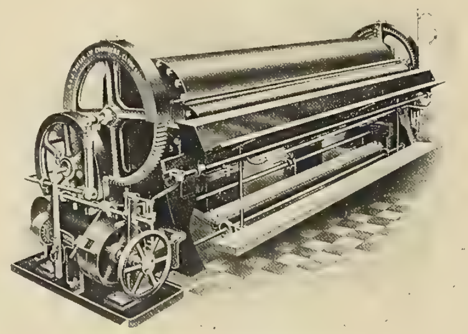
F. Merian Wheeler, inventor of the Wheeler patent surface condenser, died of heart disease Sept. 15, at Westhampton, L. I. After graduating from the Polytechnic Institute of Brooklyn, Mr. Wheeler took up hydraulic and marine engineering as a specialty, and for over thirty-four years was associated with the George F. Blake Manufacturing Company. He was a director and secretary of the company, and later a director of the International Steam Pump Works, which corporation absorbed the Blake Company, the Worthington and other hydraulic works. Mr. Wheeler organized the Wheeler Condenser & Engineering Company, whose works are located at Carteret, N. J. He has also been officially connected with the Ludlow Valve Manufacturing Company. Mr. Wheeler was a charter member of the American Society of Mechanical Engineers and the Society of Naval Architects and Marine Engineers. He was also a member of the American Society of Naval Engineers and the Engineers' Club of New York,

STEAMSHIP LAUNDRIES.

A comparatively recent development in the modern steamship is the equipment of ocean-going passenger vessels with up-to-date power-driven steam laundry plants, capable of dealing effectively with the passengers' wearing apparel and the requirements of the ship. The last three vessels built on the Clyde for the Orient Royal Mail Company, Ltd., viz.: the *Orsova,* the *Osterley* and the *Otway,* were each fitted with a modern steam laundry by Messrs. D. & J. Tullis, Ltd., of Clydebank. The laundry plant of each of these vessels consists of two all-metal power-driven washing machines, with a stationary outside casing of galvanized steel plate and an inner revolving shell of sheet brass, inside which the goods are washed. This washing cylinder is perforated with holes in a very ingenious manner, the punching being done from the inside of the sheet, and the holes countersunk and round off so that the washing surface on the inside of the shell, with which the goods actually come into contact, is absolutely smooth and free from any rough projection likely to damage the linen.

From the washing machine the goods are conveyed to a hydro-extractor, the purpose of which is to remove all loose water from the articles as they are taken from the washing machine before they are hung up to dry. This machine also consists of an outer or stationary casing of steel boiler plate, and an internal perforated steel basket, which revolves at 1,400 revolutions per minute. The action of the machine when running packed with goods is to extract the loose water and throw it out at the perforations, after which it is drained off from the machine. The extracting process only occupies about 15 to 20 minutes, in which period articles to the aggregate of 40 pounds weight when dry can be treated.

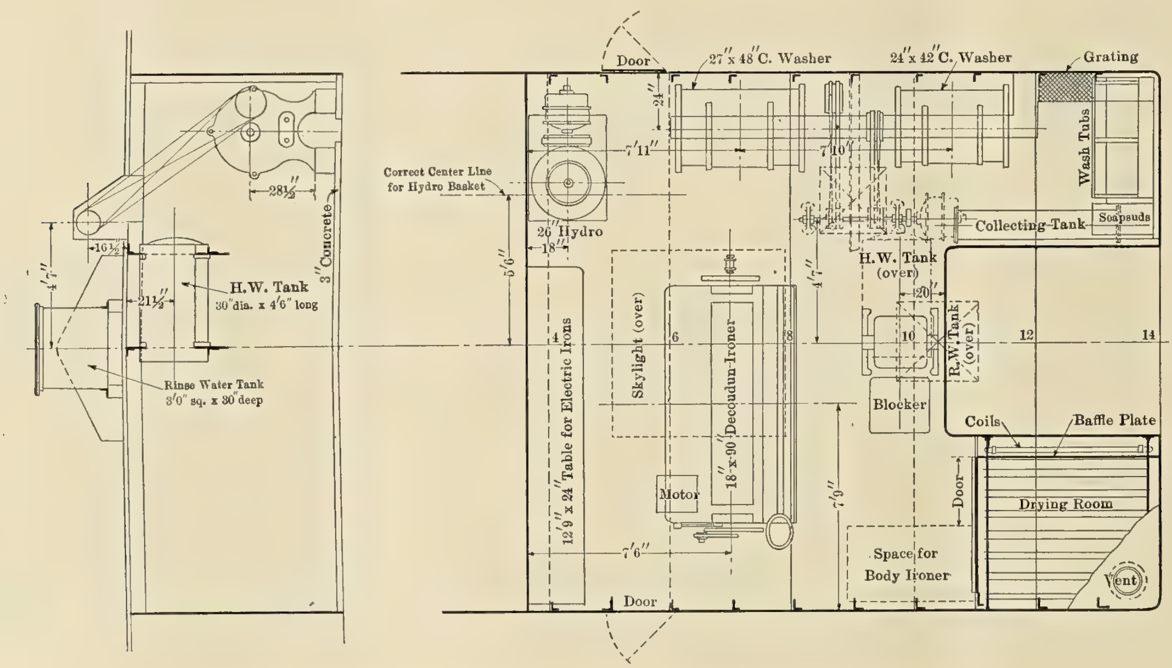
process consists in passing the goods over the steam-heated bed, where they come into contact with the revolving roller, and are finished in the desired manner. This type of machine is specially adapted for finishing table linen, or any article where it is desirable to impart a shine or polish. An ingenious device is attached to the machine in the shape of an automatic



DECOUDUN IRONING MACHINE.

finger guard, which stops the machine instantaneously should the worker's fingers come into contact with the revolving roller. All danger of accident is thus obviated.

An important section of the installation is the soapy-water saving apparatus, the object of which is to collect and re-use the rinse water which is not actually dirty. The installation consists of a steel collecting tank, into which is led all rinse water from the washing machines, hydro-extractor and wash tubs. From this collecting tank it is forced up into an overhead storage tank by means of a powerful ejector, and from that point it is redistributed to the machines requiring same. The economy of an apparatus of this description is consider-



ARRANGEMENT OF LAUNDRY ON THE NEW STEAMERS OF THE ORIENT ROYAL MAIL LINE.

The next process is hanging up to dry, which is accomplished in a small chamber measuring about 8 feet by 6 feet, fitted with tubular hanging rails and heated to a high temperature with steam pipes. After drying, the goods are ready for finishing in the calender, which is of the single roller or Decoudun type. This machine, which is of heavy and powerful design, consists of a steam-heated polished bed of cast iron, in which a padded cast iron roller revolves, also steam heated. The

able, and most important in view of the scarcity of fresh water at sea.

In addition to what has already been described there is a set of teakwood hand-wash tubs, in which special articles, such as ladies' finery, can be washed by hand; a soap and soda dissolving tank for supplying the machines in the laundry; a yellow pine hand-ironing table with electric irons; a hot-water tank with steam coil for supplying hot water to the

machines in the laundry requiring same, and a complete equipment of shafting pulleys, belting and piping services.

The power in the laundry is provided by electric motors, three in number; one of 2 brake-horsepower, driving the two washing machines through a shaft, and a 2 brake-horsepower motor driving the hydro-extractor, and one of similar power being directly coupled to the Decoudun ironing machine. It will be seen therefore that all sections of the laundry can be driven independent of each other.

Each of the three ships above referred to has the same equipment of laundry machinery, although the "lay out" is slightly different in each case.

Rulings of the Office of the Supervising Inspector-General of the United States Steamboat Inspection Service.

Experimental tests having been conducted of oxy-acetylene welding done by the Vulcan Brazing & Machine Company, of Philadelphia, Pa., such work done by the above-named company may be permitted on vessels subject to the inspection of this service.

Under date of July 14, in a letter to the Supervising Inspector of the Third District, relative to section 1, Rule 1, General Rules and Regulations of the Board of Supervising Inspectors, edition of January, 1910, and also with reference to section 4430 and 4431, R. S. U. S., all having to do with the testing of plates used in the construction or repairs of steam boilers, the Local Inspectors at Norfolk, Va., holding that from the wording of the article and sections referred to it is possible to assume that *all* material entering into the construction or repairs of marine boilers must be tested in the presence of an assistant inspector, and stamped by him with the official stamp of the Government and his initial stamped thereon, this office stated, "that from a careful reading of sections 4430 and 4431, R. S. U. S., and of section 1, Rule 1, General Rules and Regulations, edition of January, 1910, and by comparison of section 1, Rule 1, General Rules and Regulations, edition of 1910, with the editions of previous years, and after a consideration of the sections that follow in Rule 1, General Rules and Regulations, this office is of the opinion that it was the intention of the Board of Supervising Inspectors to require, not that all material entering into the construction or repairs of marine boilers must be tested in the presence of an assistant inspector and stamped by him with the official stamp of the Government and his initials stamped thereon, but only material used in the construction or repairs of marine boilers subject to tensile strain, which must be tested in the presence of an inspector before it is stamped with the tensile strain that it will bear."

Numerous questions having been asked by inspectors and others concerned, relative to the Motor Boat Act effective July 9, 1910, the following excerpts of letters written by this office relative thereto are given for the information and guidance of all concerned:

Under date of July 6, in a letter to the Supervising Inspector of the Third District, answering certain questions propounded by the Local Inspectors at Charleston, S. C., this office stated that the Local Inspectors at Charleston, S. C., "may be informed that *no* vessels, whether propelled by motor or by steam and not more than 65 feet in length, except tug boats and tow boats propelled by steam, require licensed officers unless they carry passengers for hire, in which event they must be in charge of a licensed operator.

"A licensed operator is allowed to take charge of a vessel, whether propelled by motor or by steam, when she is carrying passengers for hire and is less than 65 feet in length, except tug boats and tow boats propelled by steam, which must have the usual licensed pilots and engineers.

"Motor boats over 15 gross tons engaged in the carriage of freight or passengers for hire must be inspected; if they are also over 65 feet in length they must carry a licensed engineer and a licensed pilot.

"*All* steam vessels must be inspected as heretofore, but if the steam vessel be used for pleasure purposes only, and is less than 65 feet in length, then a licensed operator or engineer is not required."

Under date of July 6, in a letter to the Supervising Inspector of the Third District, answering questions propounded by the Local Inspectors at Jacksonville, Fla., this office stated, "that the design of the engine, boiler or other operating machinery of motor boats more than 40 feet in length and not more than 65 feet in length propelled by machinery driven by steam is to be approved only at the first time, unless the design is later changed, in which event it must again be approved by the local inspectors.

"As this office holds that *all* steam vessels are still subject to *inspection*, it is necessary that such steam vessels carry all of the life-saving equipment heretofore required.

"A vessel over 40 feet in length and not more than 65 feet in length, propelled by machinery driven by steam, that does not tow for hire, is to be considered a towing boat within the meaning of the Act of June 9, 1910.

"A steam pleasure yacht more than 40 feet in length and not more than 65 feet in length, propelled by machinery driven by steam, requires no licensed officers, but if she carry passengers for hire she must be in charge of a licensed operator, but it is not required that she be in charge of a licensed engineer. Such a vessel would be required to carry all life-saving equipment heretofore required."

Under date of July 7, in a letter to the Supervising Inspector of the Second District, relative to the New Motor Boat Act, this office stated, "In reply to your question, 'Is the definition of a motor boat contained in this Act to be considered as repealing the provisions of section 4426 in so far as they relate to towing vessels of Class 3 motor boats', you are advised that the provisions of section 4426, R. S. U. S., in so far as they relate to towing vessels *propelled by steam*, are not repealed. If a *steamer* be over 15 gross tons engaged in the transportation of freight or passengers for hire and be *less* than 65 feet in length, it is necessary that she be inspected, and that she be in charge of a licensed operator, but it is not required that she have a licensed engineer. In other words, *every* steam vessel is subject to inspection as heretofore, but not every steam vessel is required to carry the usual licensed officers as heretofore.

"With reference to motor boats other than those propelled by steam, it may be stated that if the boat is over 15 gross tons engaged in the transportation of passengers or freight for hire, she must be inspected and she must be in charge of a licensed operator, but the usual licensed pilot and licensed engineer are not required unless she *also* be over 65 feet in length. If a motor boat propelled by other means than by steam under 65 feet in length be engaged in the transportation of passengers for hire, then it is required that she be in charge of a licensed operator. Motor boats propelled by other means than by steam engaged in towing are required to have neither inspection nor licensed officers."

A New Steamer for the Eastern and Australian Trade.

Messrs. Workman, Clark & Company, Ltd., Belfast, have recently designed and built a new steamer for the Eastern & Australian Steamship Company, Ltd., London. The new vessel has been named *St. Albans*, and is 381 feet in length, with a gross tonnage of about 4,500. She will trade between Australian and Chinese ports.

Accommodation for 63 first class passengers is provided in commodious staterooms arranged for one, two and three persons on the bridge and upper decks, and for 36 second class passengers in large, four-berth rooms at the after end of the bridge space. The first class public rooms include a spacious and well lighted dining saloon, a tastefully furnished drawing room and a comfortable smoke room. The second class passengers are provided with comfortably furnished dining saloon, lounge and smoke room. Accommodation for European steerage passengers has been arranged in the poop space, and for Chinese steerage on the main deck forward. As the vessel is intended for service in tropical climates, special attention has been given to the ventilation of the passenger accommodation throughout the vessel.

The cargo space is divided into four holds, and one of these has been insulated and prepared for the carriage of frozen meat, while the 'tween deck space over this hold has also been insulated and fitted up for meat and fruit cargoes and perishable stores. For the preservation of these cargoes and stores a plant of refrigerating machinery has been installed. Each of the holds is furnished with a large hatchway, suitably equipped with steam winches, derricks and other appliances necessary for expeditiously handling general cargo.

The propelling machinery consists of a set of triple expansion engines, having all the most modern improvements and auxiliaries and supplied with steam from four single-ended cylindrical multi-tubular boilers working under forced draft.

The vessel has been built under special survey for the highest class in Lloyd's Registry of Shipping, and fulfils the requirements of the British Board of Trade.

TWIN-SCREW FERRY STEAMERS FOR CALCUTTA.

Messrs. John I. Thornycroft & Company, Ltd., recently shipped from their Woolston Works at Southampton four twin-screw ferry steamers for the Port Commissioners of Calcutta for their passenger service. About three years ago Messrs. Thornycroft delivered seven ferry steamers to the

TYPE OF FERRY STEAMER FOR CALCUTTA SERVICE.

Port Commissioners for a new passenger service which they were inaugurating. These boats proved so successful that a further order for four boats was placed. These were erected at the Woolston Works, properly marked for re-erection, and shipped by the Peninsular & Oriental Company's line.

The following are the leading particulars of these boats:

Length over all	105 feet.
Length between perpendiculars	100 feet.
Breadth, molded	20 feet.
Depth, molded	10 feet.
Draft (loaded)	5 feet.
Speed	12 knots.
Indicated horsepower	500

The vessels are built of steel to Lloyd's A-1 (River Class) and Board of Trade requirements for special passenger certificate. Special attention has been given to the sub-division of the hull, there being no fewer than seven complete watertight bulkheads. There are two stout wood fender belts, one extending all round the vessel near the deck, and one from the forward to aft bulkheads near the waterline. A wood awning extends over the whole of the upper deck, and a navigating bridge, also with a wood awning, immediately in front of the funnel.

The machinery is placed amidships, and the arrangement of hull provides for four cabins for passengers, two forward and two aft, each with a roomy stairway and companion. Nominally the vessel is to carry 200 passengers, but there is room for a considerably larger number.

The machinery consists of two sets of tri-compound surface-condensing engines, and a marine type boiler of extra large size to deal with the rather poor quality native coal, working with natural draft, or when required with forced draft on the closed stokehold system. The cylinders are 9 inches, 13 inches and 20½ inches diameter, with a stroke of 11 inches, working at about 300 revolutions per minute. The boiler is 11 feet 6 inches diameter and 10 feet 3 inches long, with a heating surface of 1,267 square feet and a grate area of 42 square feet, with a working pressure of 180 pounds.

Steam Yacht Doris.

One of the most spacious steam yachts of recent years is the *Doris,* of 1,000 tons Thames measurement, built by Messrs. John Brown & Company, Clydebank, Glasgow, for Mr. S. B. Joel. This yacht is schooner-rigged with two pole masts, and is of the shade-deck type with a large promenade deck amidships and a built-up forecastle. The dimensions are 228 feet between perpendiculars, 270 feet length over all; breadth, 31 feet.

The accommodation is very large and compact, and includes on the promenade deck a chart room, large smoking room, owner's business room and deck shelter. On the main deck under the raised forecastle is accommodation for the quartermaster, boatswain and carpenter, also the crew's galley and crew's lavatories. Amidships there is a long range of deckhouses under the shade deck.

At the forward end is the dining room, capable of dining eighteen persons; vestibule, pantry and main galley. Aft of the engine casing and connected to the forward accommodation by a passageway is a large drawing room, with double doors opening to a deck shelter at the after end. The captain's room is situated between the engine and the boiler casings.

On the cabin deck, forward of the machinery space, are the principal rooms for the owner and his guests, consisting of five staterooms, bath rooms and dressing room. Immediately aft of the machinery space there are a children's nursery and dining room, five staterooms, bath rooms; then right aft are cabins, etc., for the servants. The officers and crew are berthed forward, with exceptional accommodation.

The propelling machinery consists of two sets of triple-expansion engines, each having four cranks, with cylinders 16 inches, 26 inches and (two) 30 inches diameter by 26 inches stroke, driving twin screws. There are two return tube boilers. The bunkers are ample for a large cruising radius, and there is a complete installation of electric light and refrigerating machinery. One of the special features of the yacht is that it is arranged to coal through ports in the topsides. This has never been done before in a yacht of this type.

Messrs. G. L. Watson & Company, Glasgow, designed and have superintended the construction of the *Doris.*

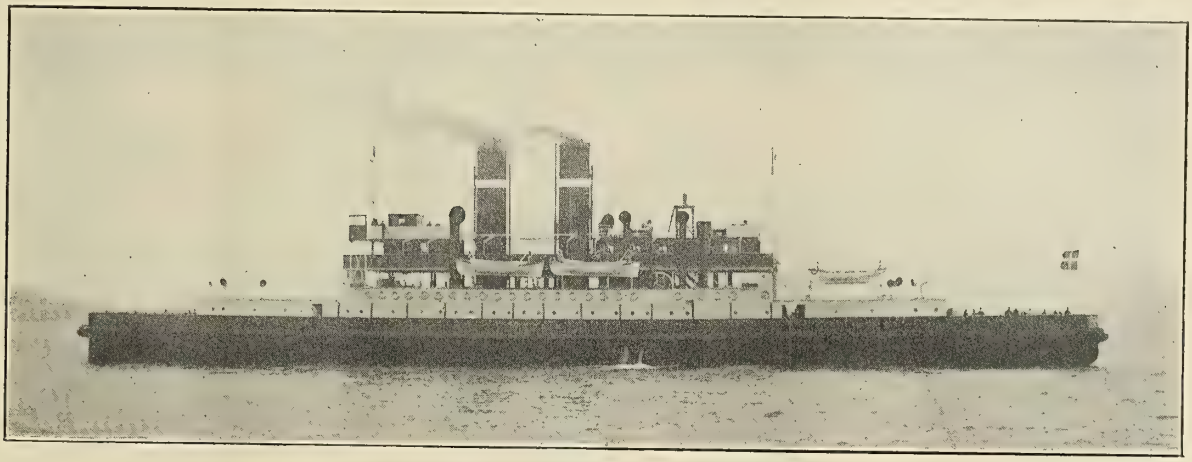
Danish Car Ferry Odin.

BY AXEL HOLM.

Burmeister & Wain, Copenhagen, Denmark, recently built for the Danish Government railroads a new car ferry which has been named the *Odin*. The hull is 293 feet 9 inches long over all, and 290 feet long on the waterline. The breadth over the guards is 58 feet 9 inches, and on the waterline 48 feet 6 inches. The molded depth is 18 feet 7 inches, and the full load draft, when the vessel is loaded with 300 tons of cars on the deck and 130 tons of coal in the bunkers, is 12 feet 5 inches.

The ferry is a double tracker and has twin-screw engines, with a combined horsepower of 1,800, which, on her trial trip, drove the vessel at a speed of 15 knots. In all details the ferry is a sister ship of the *Christian IX*, built by the same firm during 1908, plans and descriptions of which appeared in the April, 1909, issue of International Marine Engineering.

The *Odin* is now plying in regular service between the ports of Korson and Nybork, Denmark.



TWIN-SCREW, DOUBLE-TRACK DANISH CAR FERRY ODIN.

Steamship Akassa.

Messrs. Irvine's Shipbuilding & Dry Docks Company, Ltd., West Hartlepool, have recently built at their Middleton Shipyard the steel screw steamer *Akassa* for Messrs. Elder, Dempster & Company, Ltd., Liverpool. This is the eighth vessel built for this company, and is a sister ship to the *Tamele* and *Onitsha*. The dimensions of the *Akassa* are: Length, 375 feet; beam extreme, 50 feet; depth molded to upper deck, 25 feet 3 inches, having all the 'tween decks and houses 8 feet in height. She is classed 100 A1 at Lloyds, and has a cellular double bottom all fore and aft, with fore and after peak tanks for water ballast.

The vessel is divided into seven watertight compartments by six transverse bulkheads, and all appliances for the rapid loading and discharging of cargo have received every attention, there being nine powerful steam winches of the builder's own design, and ten derricks capable of lifting five tons each; provision is made on each mast for a special derrick dealing with 30-ton loads, while the whole of the mast arrangement is strengthened to lift 40 tons.

Accommodation for 30 first class passengers, in two-berth staterooms, is arranged under the bridge, with ladies' cabins, lavatories, baths, etc., and second class passenger accommodation at the after end under the poop. The dining room is on top of the bridge and the smoking room and accommodation for the captain and officers is on the promenade deck above, which extends the whole length of the bridge. The engineers and other officers are berthed in steel houses under the bridge deck at the after end. The vessel has steel decks sheathed with wood on the poop, bridge, forecastle and promenade decks, and the whole of the passenger accommodation and public rooms are bright and cheerful, being lighted by large sidelights and specially ventilated in view of the tropical climate in which the vessels will be engaged. The height of the ceilings, from deck to deck, is 8 feet. Under the second class accommodation aft, provision is made for large icehouses, mail rooms, specie rooms, paint rooms, lamp rooms and general store rooms; and spacious accommodation for the seamen, firemen and petty officers is arranged under the forecastle, with separate mess rooms and wash places for the crew and firemen.

The vessel is fitted with the usual complement of lifeboats, together with six surf boats of special design for carrying palm oil through the surf. A complete installation of electric light is fitted by Messrs. Campbell & Isherwood, including signal lamps, binnacle lamps, cargo clusters at each hatch, as well as oil lamps for emergency purposes. Steam-steering gear is placed amidships, and a quick-warping steam windlass forward, steam being supplied to all deck machinery from either of the main boilers.

The engines are of the triple-expansion type, by Messrs. Richardsons, Westgarth & Company, Ltd., Hartlepool, having cylinders 25 inches, 40 inches, 68 inches by 48 inches stroke, with three main boilers working at a pressure of 180 pounds per square inch, and capable of driving the vessel at a fair rate of speed when loaded. A Contraflo condenser is fitted, by which it is claimed a vacuum of 27 inches can be carried in sea water up to 85 degrees.

The 1911 National Motor Boat Show will be held at Madison Square Garden, Feb. 21 to March 4, under the auspices of the National Association of Engine and Boat Manufacturers. The show will be open daily from 9 A. M. to 11 P. M., excepting Sunday.

The Bureau of Navigation reports 127 sail and steam vessels of 14,020 gross tons built in the United States and officially numbered during the month of August, 1910. Of these, six steel steamers of 2243 gross tons were built on the Atlantic and Gulf coasts and five steel steamers of 8,611 gross tons on the Great Lakes.

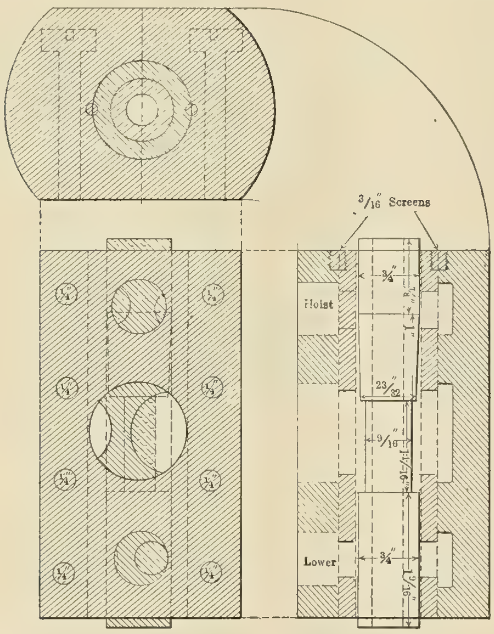
The Economy of oil fuel is shown by some comparative figures giving the cost of fuel used during one month on board seven steamers plying on the bay and rivers near San Francisco. Figures are given for the operation of these vessels using first coal then oil, and the average saving in cost of fuel per month gained by the use of oil fuel is 47 percent. This exceptional gain is due partly, of course, to the high price of coal on the Pacific Coast.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

Modification of an Ash-Hoisting Engine.

Trouble was experienced on this vessel with the ash-hoisting engine, which is of the vertical tandem type with over-hung cranks, having cylinders 3½ inches in diameter with a stroke of 6 inches, the diameter of the hoisting drum being 8 inches. For its operation the engine depended upon a D-slide controlling valve, connected to a vertical valve stem and rod, fitted with tappets for the proper regulation of hoist. About 2 inches above the valve stem stuffing-box a crosshead with two wrist pins is secured by means of a set screw. The wrist pins, and hence the controlling valve, are moved by means of a forked guide lever, connected to a horizontal shaft, which in



DETAILS OF VALVE FOR ASH-HOISTING ENGINE.

turn is operated from deck by means of a vertical shaft and bevel gears. Moving the crank on deck slightly to the right or left from its neutral position would move the valve up or down, and so hoist or lower the bucket.

The reduced steam pressure behind the valve, however, was too great to admit of its proper operation, the operator having to use both hands to start the valve, thus putting considerable strain on the valve-operating gear. The steam ports were 2⅝ inches wide, and the port opening could not be controlled on account of the great friction between the valve and seat. The result was that when the valve was jerked open the port opening would be such that the ash bucket would shoot up the ventilator like a shot out of a gun, and it might as well have been thrown down as to have been lowered by the engine.

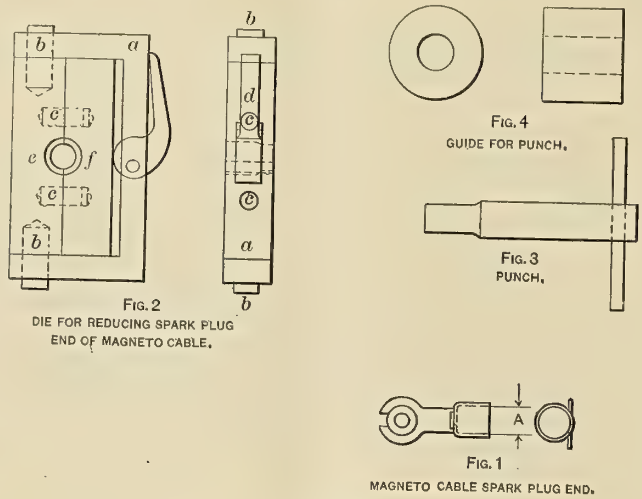
Various alterations were suggested, but none were successful, so we took out the flat controlling valve and removed the false valve seat. Measurements were then taken, and a valve chest made from a round piece of cast iron 4 inches in diameter and 4¼ inches long. This was bored, recessed drilled and faced, and a small working liner with corresponding steam and exhaust ports fitted for the valve. The valve was made ¾ inch in diameter, but still proved to admit too much steam to the cylinders while lowering the bucket, so we finally got a valve the size and shape of which is shown in the sketch. The operation of the hoist is now easily controlled and has given no further trouble.

A. N. Metzelaar,
U. S. S. *Vicksburg*. Chief Machinist's Mate, U. S. N.

Fixture for Re-Forming Magneto Cable Ends.

A handy fixture is shown below, which the writer had occasion to use for re-forming the spark plug ends of magneto cables used on automobile engines.

Magnetos with cables were bought from one company, and after some time a change was made in the cables, and it was



FIXTURES FOR RE-FORMING CABLE ENDS.

found that the new cables were 1/16 inch smaller in diameter, and, as a result, the terminal for the spark plug end of the cable was too large, and scraping this piece was out of the question, as this would involve considerable delay, which at the time could not be tolerated.

In Fig. 1 is shown the cable end; the diameter *A* being, as before stated, 1/16 inch large.

Fig. 2 shows the die for reducing the diameter *A*. This die was split in order to be able to place the work in it. The part *a* of the die pivoted on the pins *b*, which are fastened into the half of the die marked *c*; the other half was held by the eccentric which pivoted in *a*; the pin *c* locating this half of the die.

Fig. 3 shows the punch and Fig. 4 is a guide for the punch. This work was done by a boy in a small hand press and the piece trimmed on the end, this being caused by the redrawing of the metal.

C. T. Schaefer.

Precautions in Connection with Water Gages.

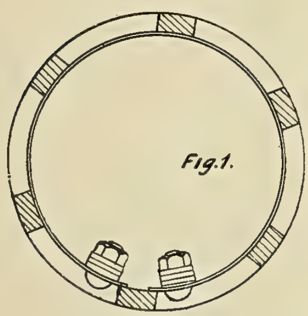
The water gage of a steam boiler, although undoubtedly a great safeguard when properly used, becomes an element of great danger when neglected, and cases are not wanting where grave explosions due to shortness of water have taken place, when the gage glasses appeared to show good water level. For this reason the gages should be frequently blown through in order to make sure that they are clear.

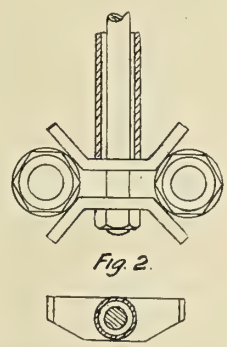
Very often after the gage glass has been drained and blown through the water rises very slowly. This is especially so in the case where the gages have pipe connections to the top and bottom of the boiler. If after having made sure that all the cocks are clear, the water still rises slowly, the water end pipes should be taken off at the first opportunity. In nine cases out of ten it will be found that the pipe is almost choked either with mud or with calcareous matter. In one case a set of these pipes was taken off owing to the sluggish action of the water in the gages, and it was found that although they were 1½ inches in internal diameter, the pipes were nearly solid with deposit. It was impossible to get even a piece of ¼-inch wire through the mud. It took a considerable amount of cleaning, probing and scraping to get them free, and there is no doubt that within a comparatively short space of time they would have been entirely blocked, in which case the gage would have been not only useless but deceptive, and given rise to a feeling of false security. Such cases show the importance of keeping water channels in a boiler completely free from incrustation and deposit.

Engine-Room Ventilators for Adjusting Engine Steam Distribution.

While the steamship ——— was on a voyage from the Gulf of Mexico to England, two or three loud knocks were heard from the intermediate-pressure cylinder, followed, before the engine could be stopped, by a loud crash and the sound of escaping steam. On investigation, after stopping, it was found that the intermediate cylinder was utterly wrecked.

The cover was lifted off as soon as possible. With its removal it became possible to guess fairly accurately what had happened. The head of one of the bolts holding the junk ring in place on the piston had broken off; the piston, on its upstroke, had punched this bolt head into the cover, which was a box casting, breaking a piece right out, this broken piece of cast iron had fallen on top of the piston, and, as it was of considerable size, on the next up-stroke the cover had been smashed. In addition, the piston rod was bent so that the cylinder in question was completely out of commission, and





APPLICATION OF VENTILATOR TO VALVE CHEST.

the only thing to do was dismantle the gear and work with the other cylinder. As the ship at that time was only three days' traveling from its destination it was not advisable to spend too much time over the repair.

The steam distribution to the damaged cylinder was by means of piston valves, but as the pistons were merely blocks of cast iron, with no packing rings, the obvious method of fastening them over the cylinder ports was not feasible, as the small holes for the valve spindle would not pass the steam readily enough. The question of cutting larger holes in the valve pistons was discussed, and dismissed as taking too long; and it was decided to make a rough wooden cover for the cylinder and attempt to adjust the expansion of the steam in the cylinders, so as to keep the pressure in the damaged cylinder as near that of the atmosphere as possible.

Just as the work was being commenced, someone discovered that one of the engine-room ventilators was just a little larger in diameter than the valve pistons in question, so it was decided to use two lengths of the ventilator to block the cylinder ports. This was accomplished in the following way:

Two lengths of the ventilator were cut off, each about 6 inches longer than one of the valve pistons, and the seam cut out. They were then cleared of paint with strong caustic soda. Two holes were drilled near the opening and ¾-inch bolts and washers fitted. These rings were then sprung into the valve chest liners over the ports, so that the openings in the rings each coincided with a rib in the port, somewhat as shown in Fig. 1. To keep these thin rings in place and press them outward a piece of iron pipe was cut to the length between the top pair of ¾-inch bolts and the bottom pair. Through this pipe a rod, screwed at each end and fitted with nuts, was placed. At each end between the pipe two curved iron washers were placed. The shape of these washers and the position they occupied relatively to the bolts in the thin iron rings is indicated in Fig. 2, which shows the lower part. The arrangement was tightened up and the steam chest cover replaced, and, as by this time the unnecessary gear of the damaged cylinder had been removed and the spindle stuffing-box blocked, the engine was started. The result was satisfactory. The steam which leaked through the extemporized packing, and floated up from the damaged cylinder, was deflected by a canvas screen into the warm upward air current at the forward end of the engine room, whence it was carried away without causing much inconvenience.

The repair occupied about five hours all told and sufficed to carry the ship to its destination.

Explosion of a Main Boiler.

While on a voyage from London to Melbourne, Australia (a voyage which, by the way, proved to be the vessel's last), one of the main boilers of the S. S. "O——" exploded. The ship was supplied with two main boilers of the multitubular type, each having three internal furnaces, 4 feet 6 inches diameter. The shell was cylindrical of a mean diameter of 15 feet 11 inches, and its length over all was twelve feet. All the material used in the construction of the boiler was steel, excepting the stays and tubes, which were iron. The steel was manufactured at Sheffield, and was inspected by Lloyd's and passed in their usual way. The fittings consisted of two spring safety valves, loaded to 80 pounds per square inch and fitted with screw easing gear, which could be worked from the engine room; two pressure gages, graduated for 130 pounds, which had been tested and found to indicate 7 pounds more than the correct pressure (I understand this variation is general throughout the range); stop valve; glass water gage; two feed checks, valves, blow-off and surface cock, and hydrokineter.

In December, 1887, a large patch was put on the center furnace; in June, 1888, a small patch was put on the center furnace, and in October, 1888, the boilers were cleaned and calked. In May, 1889, both the above patches were renewed on the furnace. In September of 1889, the combustion chamber of the center furnace had a patch put on the back plate at the bottom, and eight stays renewed. In December, 1889, the rivets in the patches on the furnace were renewed, and the bottom of the boiler calked. The above were the first and only repairs made on the boiler since it was new, in 1880.

The boiler gave way in the central furnace, at the root of the flange of the "Adamson" joint, that was fitted at about the middle of the length. A piece about ½ inch in diameter was blown out, and the plate was cracked for a length of one and a half inches, on each side of the hole. The explosion was due, we found afterwards, to the fact that the plate had become reduced in thickness by corrosion, until it was no longer able to sustain the ordinary working pressure.

As soon as the explosion took place, the fire in that particular furnace was extinguished, and it was with great difficulty that the remaining two fires were drawn. We then started to make repairs in the following manner: The hole caused by the explosion was reamed out and a ¾-inch bolt and patch put on temporarily. When the boiler was filled with water and before steam was raised, the holes in the plating forming the bottom of the combustion chamber of the center furnace gave out. These were likewise temporarily patched, and it was decided to reduce the steam pressure from 80 pounds to 60 pounds, and the safety being set accordingly the vessel completed her voyage with the latter pressure.

On the arrival of the vessel in port, a number of holes having been bored in the furnaces and combustion chambers, the corrosion of the boiler was found to extend over a limited area, the plates being reduced in thickness from 7/16 inch to 1/16 inch at the thinnest part. The plates towards the bottom in the center and port combustion chambers were reduced in thickness from 7/16 inch originally to 5/16 inch and 3/16 inch respectively. Those parts were not easy to get at on the water side, as there was no manhole in the back of the boiler through which an examination could be made. The drill had never before been resorted to, and the hammer test would not have been an altogether reliable one. In the opinion of those in charge, the corrosion that had taken place at the parts above mentioned was due to the continued buckling and oxidation to which the plates had been subjected, and this was considerably augmented, and the pitting encouraged by the position of the feed water inlets on the back of the boiler. There were no internal pipes to these connections, consequently any acids brought in by the main feed would be more active about the center combustion chamber and furnace, where the plates seem to have deteriorated most, and this supposition was borne out by the fact that the patch which was put on the chamber back in the latter part of the previous year has wasted from 7/16 inch in thickness to 3/16 inch.

The cold-water feed from the donkey engine was delivered in the vicinity of the corroded plates in the port chamber. The process usually adopted in raising steam was thus: The center furnace was generally fired six hours ahead of the others, in fact, steam was often on the boiler before the other fires were lighted. The straining, in consequence, must have been very severe.

This explosion occurred from the defective condition of one of the furnaces of the boiler. The plate at the part that gave way was nearly corroded through. The vessel was temporarily disabled by the giving out of the boiler, but fortunately no serious result followed. It seems also that the boiler gave out in the bottom of the combustion chamber after the furnaces had been repaired. The corrosion, it is said, was only local; at any rate, ship and boiler were found to be much out of date, and so both found their way to the scrap heap. F. J. S. N.

On a recent voyage the *Mauretania* clipped 10 minutes from the westward trans-Atlantic record.

Fixture for Machining a Square Hole in a Punch Press.

Couplings with square holes through them are quite common in automobile work, and considerable thought has been given to their manufacture. The writer will endeavor to describe a fixture that has been successfully used for machining square holes in a punch instead of broaching them, as most manufacturers do. These couplings will run absolutely true if placed on an arbor and tested in a lathe.

Fig. 1 shows a specimen of the work done, while Fig. 2 shows the punch for punching the hole. This punch should be made with a clearance of 1/64 inch from cutting edge to depth

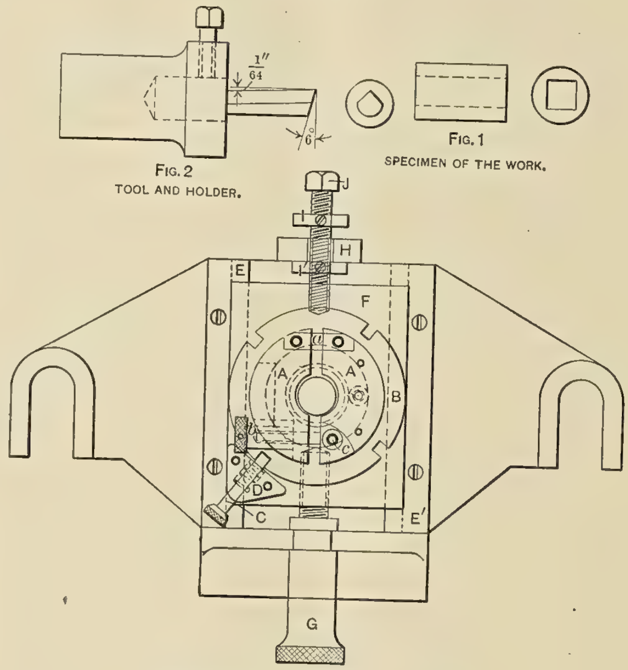


Fig. 2 TOOL AND HOLDER.

Fig. 1 SPECIMEN OF THE WORK.

Fig. 3 FIXTURE FOR HOLDING THE WORK.

METHOD OF MACHINING A SQUARE HOLE.

of cut, so that the chips will not heat up the punch, and the punch should have a shearing angle of 6 degrees, while the tool-holder shear is made to suit the press.

In the fixture shown in Fig. 3, *A* is a vise for holding the work, pivoting on hinge *a* and clamped by the nut *b*, which threads on a rod end, pivoting on pin *c*. The dividing device *B* is held in position by pin *C*, which is supported by a spring in the piece *D*, to hold pin in position in the dividing device. The vise and dividing device are fastened on a plate *F*, which is grooved on the sides and guide by the small plates *E E'*, and its movement back and forward is controlled by the screw *G*, while *H* is a stop for the travel of the fixture, and is controlled by the collars *I I'*, which are fastened to the set screws *J*, passing through a clearance hole in *H*.

The vise in the fixture could be made to carry split bushings, so that different classes and sizes of work could be done at a small expense, such as the ends of cam shafts or any piece which might require a square hole. C. T. Schaefer.

White Metal Safety Plugs.

In a good many ocean-going passenger vessels built in America, it is the custom to put safety plugs in the tops of the boiler combustion chambers, and one disadvantage which this practice has is that the white metal occasionally gets blown out of the plug even when the boilers

are not by any means short of water. This is probably due to deposit on the water side of the plug, allowing the heat of the boiler to operate on the plug while preventing the water in the boiler from keeping it sufficiently cool to prevent the white metal from liquifying.

A case in point may not be without interest. At the time of the occurrence the vessel had been at sea six or seven days, and when there was a three-fourths glass of water, and the ship was on even keel, the plug blew out. It was, of course, necessary to draw the boiler fires at once and to blow the boiler out and cool it down. When the engineers were able to get inside the boiler, which was two hours after the occurrence, and attempted to put a new plug in, it was found that the brass plug could not be moved at all, as it had become rusted into its seating. The boiler was, of course, so hot that no one could stay inside for very long, so that all that could be done at the time was to get a suitable tap and put a screw thread through the plug in the hole where the white metal had been and to screw a ¾-inch brass bolt into the hole thus formed, and this repair lasted until the vessel was brought into port, when the brass plug was drilled out and a new safety plug put in its place.

Defective Valve Gear.

While the steamship "D———" was on a trip from Dublin (Ireland) to Liverpool there was trouble caused by the low-pressure valve. The engines were brought up at sea through the cotter coming out of the slide valve cap, owing to the split pin through the cotter having broken off where it was opened, and, consequently, working out and allowing the cotter to work back.

The valve was then left loose on the spindle, and stopped on the cylinder face, owing to the pressure of steam on the back. We took the door off, replaced the cotter and split pin, and proceeded on our voyage. When we got to port we removed the split pin, and two pieces of steel plate were made duplicate with the end of the cotter. We then drilled a hole through the three and tapped them right through, having one plate each side of the cotter fastened with a ⅜-inch steel bolt.

F. J. S. N.

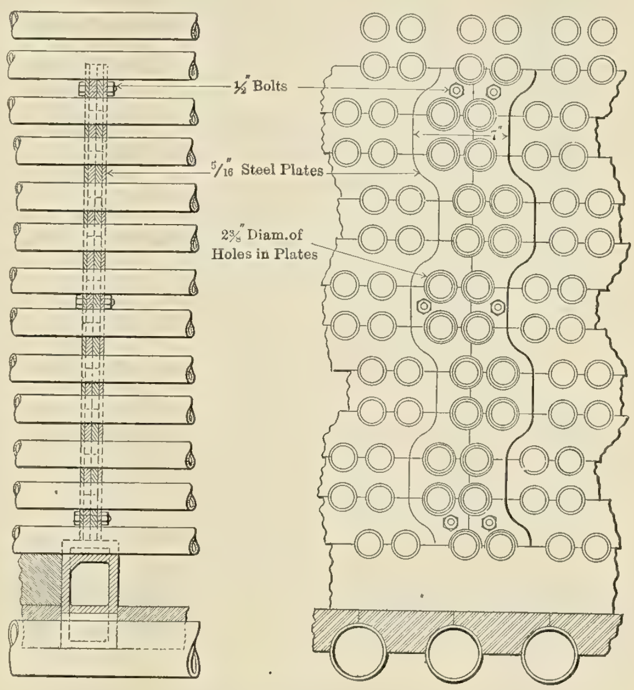
Flame Plates.

I have found in the course of my experience in repairing Babcock & Wilcox boilers, especially the larger type used on the armored cruisers of the United States navy, that the flame plates are not secured in the center of the boilers. This is a mistake, as these boilers have twenty-seven elements, and when a flame plate is 8 feet long, and is placed in position in the boiler and only secured at the outside end and the opposite end, a length of 8 feet from the securing point is allowed to go without being secured. The tubes being on an incline, the end which is in the center of the boiler sags and moves out of alinement, since there is nothing to hold it in position. This defect is hard to detect, occurring as it does in the center of the boiler, and it does not need to fall out of line a great deal to defeat the purpose for which it was placed there.

Because of this defect the products of combustion are allowed to pass directly to the smoke pipe instead of being consumed, and this causes the baffle plates, the boiler casings and the uptakes to become burned and distorted. The overheating of the casing at this point causes it to leak, and the cold air mixing with the hot gases interferes with combustion and increases the consumption of coal.

To remedy this defect I have taken four steel plates, 5/16 inch thick by 7 inches wide, and the required length, which in this case was long enough to take in twelve rows of 2-inch tubes.

These plates were a duplicate of the header face, except that the holes in the plates were enlarged to 2⅜ inches diameter. The holes were enlarged for the following reasons, viz.: to allow for the natural expansion of the tubes under heat; to allow the removal of a broken tube and to facilitate the removal of a broken flame plate. In order to insert these plates it was necessary to remove the 2-inch tubes from the three headers in the center of the boiler to allow a man to go in



METHOD OF SECURING FLAME PLATES AT CENTER OF BOILER.

and set the flame plates in line and to set the securing plates above described, on each side of the two rows of flame plates, in a vertical position, bolting them to each other at top, center and bottom, in this manner securing all the flame plates so that they will be held in a vertical position one above the other, making a perfect wall and baffle. The sketch shows the position of the flame plates and the securing plates in position.

Vallejo, Cal. C. J. Collins,
Chief Machinist, U. S. N.

A Broken Shaft.

The steamship "E———" was at sea, and everything was running well and smoothly, when, without warning the second length of tunnel shafting broke across the bearing, carrying the bearing completely away. The engines by this time were stopped, but, owing to the way on the ship, causing the propeller to revolve, the after end of the shafting twisted round on the top of the forward part, bending the broken ends badly. Immediately following this, the tail shaft, propeller, and broken tunnel shafting all slipped out against the rudder post. We then got screw jacks, patent blocks and tackles on to the shaft and worked it in, we then got the ends together as well as could be done, and fastened bands around the break as strong as the material at hand would allow. We then proceeded dead slow until assistance arrived, coming into port in tow of another steamer, and when we got there we took out the broken shaft and had a new one put in, and two lengths of tunnel shafting abaft the break sent ashore and trued up.

F. J. S. N.

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Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Saving Life at Sea.

Certain phases of the question of saving life at sea were considered in our last issue, and certain other phases of the same question are discussed by the same author this month. This discussion is confined to the question of the construction of the lifeboats which a vessel should carry and the means for lowering and disengaging them from the vessel while at sea. It is obvious, of course, that any apparatus designed to be used in an emergency or for the purpose of rescue either of a single person who has fallen overboard or of the entire ship's crew and passengers, when it is necessary to abandon the ship, should always be in perfect condition and ready for immediate use. Further, every device which will aid in the rapid execution of the few maneuvers which are necessary in the lowering of boats and safeguarding the lives of those on board should be given the minutest attention. No less important than the mechanism of the life saving apparatus itself is the personal factor or the degree of proficiency with which the crew is trained to perform its duties in an emergency. On merchant ships discipline is apt to appear to the eye of the casual observer somewhat lax. Much of the ceremonious naval etiquette practiced on a warship is entirely absent; but this does not mean that the authority of the officers over the crew is any less, nor that there is any laxity in the prompt obedience of the crew to their superiors. In general, as has been proved in the comparatively few serious disasters on board modern passenger steamships at sea, no fault could be found with the training of the crew. Invariably both officers and crew display great coolness and bravery in times of danger. With the certainty, therefore, that whatever apparatus is provided for saving life will be kept in good condition and properly manned, it is encouraging to see what developments have been made in life-saving apparatus which tend to increase the safety of ocean travel.

Marked improvements have been made during the last few years both in the design of the davits by which the boats are handled and in the design of the apparatus by which the boats are disengaged from the falls. It seems somewhat strange that so many years should have passed and so much improvement have been made in the construction of both the hull and machinery of steamships before any material improvement or modification was made in the davits for handling ships' boats. Although a most important part of the vessel's equipment, davits have until recently been constructed according to the same inconvenient and cumbersome designs which prevailed in the days of sailing ships. Since the light of scientific invention has been turned on this problem, however, new and common-sense methods have come into use whereby fewer men are needed to operate the davits and the davits themselves permit of swinging the boat away from the vessel's side a sufficient distance so that the ship can have considerable heel without the boat being dashed against its side when lowered. It is frequently suggested that the lifeboat should be lowered by power, using either small steam engines or electric motors for this purpose. Undoubtedly this would be an advantage if adequate hand gear was also provided which could be depended upon in case the source of power was damaged, as it very probably might be in event of collision or other mishap. Devices to be used in emergencies, however, should be made as simple as possible, and no complications which might cause confusion or delay at a critical moment should be tolerated.

Problems concerned with the safeguarding of life at sea include not only those dealing with the work of rescue, once an accident has occurred, but also the preventive measures which can be taken to minimize the possibility of ever having to depend upon the life-saving appliances which are installed. Modern developments in engineering have done much to solve this class of problems and the opportunities for serious accidents at sea are daily becoming less. Since the advent of the steel ship it has become possible to so sub-divide the hull with watertight bulkheads that, except in extreme cases, the vessel may be kept afloat at least until the

passengers and crew have escaped, even if the hull is seriously damaged below the waterline by collision or stranding. Theoretically, almost perfect safety to the vessel could be gained by a sufficiently minute subdivision of the hull into watertight compartments; but, practically, the cost of construction, the added weight to the hull and the breaking up of large cargo holds make it impossible to carry the watertight sub-division of a merchant vessel beyond certain limits if the vessel is to be a paying proposition. We believe, however, that present practice in this regard should be improved, particularly in the matter of sub-dividing the machinery space, so that a portion of the steam-generating apparatus, some of the pumps, and, if possible, part of the propelling machinery, can be kept intact after a collision causing admission of water to the machinery space. How much depends upon this was demonstrated by the sinking of the White Star steamship *Republic.* More information is also needed on the question of the strength of watertight bulkheads. Many bulkheads which to-day pass as watertight are not sufficiently strong or well braced to stand the test should they ever be subjected to full water pressure; and once a bulkhead begins to work, even if watertight in the beginning, leaks rapidly develop and its usefulness is destroyed. The adequate sub-division of a vessel by watertight bulkheads, and the proper design of such bulkheads, we believe to be highly important considerations among the precautionary measures which can be taken to save life at sea.

The Design of Columns for Ship Work.

We are beginning in this issue publication of an article which discusses very thoroughly the design of columns for ship work. Like almost every other part of a ship's structure, the columns and struts must be designed to withstand certain secondary loads whose magnitude cannot be determined exactly. This fact alone complicates the design of a ship's structure vastly more than that of a bridge or building, where all conditions can be carefully considered and provision made for them. The information on which this article is based is that acquired by the Bureau of Construction and Repair for the purpose of arranging a set of tables showing the safe unit loads of columns having a wide range of length ratios and constructed of various materials. In stating the requirements for ship work column tables emphasis is laid upon the fact that tables are preferable to formulas, because they are more convenient for office use, and since the formulas from which the tables are derived need not be simple in form, they can be made to agree more exactly with existing conditions. The tables, of course, should have a wide range of applicability, since the length ratios of columns for ship work must cover a wide range, the majority of them being wholly outside the range of usual structural engineering practice. Furthermore, they should be applicable to a wide range of materials, including various grades of iron and steel, brasses, bronzes and various kinds of wood. Tables which meet these requirements necessarily involve a great deal of labor for compilation and necessitate a careful review of all existing experiments, formulæ and investigations regarding the strength of materials under compression. The value of the tables will, of course, depend upon the thoroughness with which this work is carried out and the judgment used in the selection of the methods of calculation, as well as upon the extent and reliability of the data available. Recent investigations as to the strength of columns have done a good deal to upset existing theories and prove the inadequacy of existing formulæ when applied to problems of structural engineering. When this work is carried beyond the usual range of length ratios which are used in structural engineering, and an attempt is made to take account of the various complications which enter into ship work, it is evident that the lack of sufficient and comprehensive data will hamper the work. However, the problem has been attacked with a full knowledge of its limitations, and the results, we believe, will prove of great value to ship designers.

Precautions in Handling Oil Fuel.

Certain precautions must be observed in handling oil fuel on board ship if accidents such as that which occurred recently on the *North Dakota* are to be prevented. Apparently the accident on the *North Dakota* was due to leaky valves or leaky joints in the piping at a point where the temperature was high enough to ignite combustible gases. In view of this, it should be ascertained before taking oil on board that all valves and joints in the oil piping system are absolutely tight and efficient. Frequent observations should be made to insure that oil is not accumulating in the filling funnel. This is an indication of leaky valves, and the valves should be made tight at the first opportunity. All oil fuel tanks should be properly ventilated, an escape being provided for volatile gases at a safe point well above the deck of the ship. No oil should be allowed to accumulate in the bilges or on the stokehold floor plates, and a careful watch should be kept of the bilges to ascertain whether they contain any oil. Lighted material should positively be kept away from the bilges, and if any oil is discovered in the bilges the oil supply to the boilers should be shut off immediately, and, if coal fires are alight, they should be extinguished by water. If the oil in the bilge shows any signs of being overheated, water should be directed into the bilge to cool the oil and the ship's pumps used if necessary to clear the bilge. With reasonable care, there should be no danger of a fire due to oil fuel in the stokehold. Should a fire occur, however, prompt and effective measures should be taken to overcome the blaze.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		Aug. 1.	Sept. 1.
Florida	20,000	20¾	Navy Yard, New York	71.0	74.2
Utah	20,000	20¾	New York Shipbuilding Co.	83.2	85.5
Arkansas	26,000	20½	New York Shipbuilding Co.	39.5	43.9
Wyoming	26,000	20½	Wm. Cramp & Sons	32.3	35.5

TORPEDO-BOAT DESTROYERS.

Paulding	742	29½	Bath Iron Works	93.4	98.9
Drayton	742	29½	Bath Iron Works	88.1	91.7
Roe	742	29½	Newp't News Shipbuilding Co.	97.1	99.3
Terry	742	29½	Newp't News Shipbuilding Co.	91.5	93.5
Perkins	742	29½	Fore River Shipbuilding Co.	92.3	93.8
Sterrett	742	29½	Fore River Shipbuilding Co.	88.4	89.8
McCall	742	29½	New York Shipbuilding Co.	89.6	95.5
Burrows	742	29½	New York Shipbuilding Co.	87.5	92.7
Warrington	742	29½	Wm. Cramp & Sons	79.5	81.4
Mayrant	742	29½	Wm. Cramp & Sons	80.8	82.0
Monaghan	742	29½	Newp't News Shipbuilding Co.	28.4	31.3
Trippe	742	29½	Bath Iron Works	56.7	62.6
Walke	742	29½	Fore River Shipbuilding Co.	47.6	52.8
Ammen	742	29½	New York Shipbuilding Co.	56.3	65.4
Patterson	742	29½	Wm. Cramp & Sons	40.7	44.6

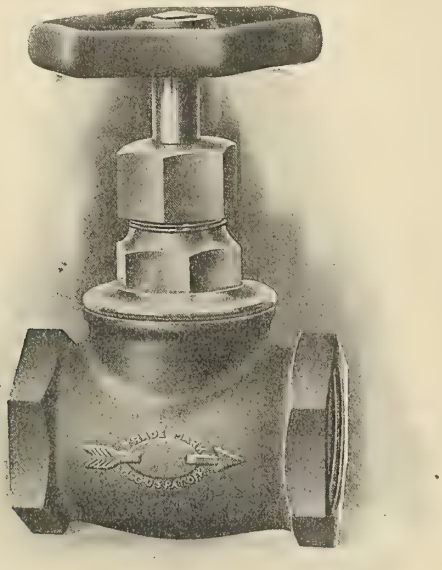
SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co.	97.8	98.4
Seal	...	..	Newp't News Shipbuilding Co.	52.2	54.4
Carp	...	..	Union Iron Works	60.0	62.0
Barracuda	...	..	Union Iron Works	60.0	62.7
Pickerel	...	..	The Moran Co.	56.8	58.1
Skate	...	..	The Moran Co.	56.8	58.1
Skipjack	...	..	Fore River Shipbuilding Co.	48.6	54.0
Sturgeon	...	..	Fore River Shipbuilding Co.	46.2	52.5
Tuna	...	..	Newp't News Shipbuilding Co.	29.9	31.8
Thrasher	...	..	Wm. Cramp & Sons	7.9	10.8

ENGINEERING SPECIALTIES.

A New High-Grade Valve.

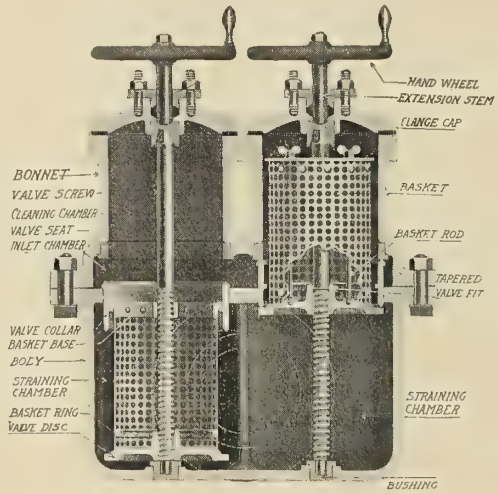
Arrow bronze globe, angle and cross valves are a recent product placed on the market by the Star Brass Manufacturing Company, Boston, Mass., and this new valve is of standard weight, mechanically designed so as to be correct and of



full pipe size area. It is expressly designed to fulfil the existing want for a low-price standard weight valve, and is not made for competition with the so-called "competition" type of valves. These valves are carefully made of the best steam metal, all parts being interchangeable. It is made in three styles, globe, angle and cross, with screw ends. Each valve is tested to 300 pounds per square inch hydrostatic pressure before shipment.

Multiple Strainers.

Nearly all sources of water supply, especially for circulating water, contain an immense amount of suspended matter, and while attempts are often made to remove this by placing a strainer around the suction pipe foot valve, this only transfers the source of trouble. The strainer soon becomes clogged and it is necessary to shut off the pumps while it is being cleaned. If the water is being used for condensers this means the loss of the vacuum and throwing an extra load upon the power equipment of the plant, and if there is no reserve power it means shutting down the plant. In order to get



around these difficulties, the Lagonda Manufacturing Company of Springfield, Ohio, has recently perfected a multiple strainer for removing impurities in feed water, circulating water, etc. These strainers can be installed in any position, horizontal, vertical or inclined. They also have the advantage that they are made up of different sections, which can be cleaned, one at a time, without interrupting the flow of water.

The strainer consists of a cast iron body having a number of removable strainer baskets, the number depending upon the size of the line. As these baskets can be easily removed for cleaning without shutting down the pumps, the mesh is made very fine; they thus eliminate more foreign matter than any other type of strainer. The water enters through the inlet pipe, passes up to the top of the valve chamber, where it divides, going down through all of the baskets in multiple. When it is desired to clean the strainer, one of the baskets is drawn to the upper part of the chamber by turning the handwheel; at the same time the valve collar is forced tightly against the valve seat and the valve disc on the bottom of the basket seats on the valve collar. This is all done automatically and entirely shuts off the water supply from the section containing the basket to be cleaned. By means of a small bypass the pressure in this chamber is now relieved and the bolts at the top loosened and the flange cap tilted over, exposing the basket. The basket can now be taken out and cleaned. In replacing the basket the operations are exactly the reverse. The next basket can now be removed in the same way and the whole strainer cleaned without shutting off the water. Should an obstruction rest upon the top valve collar, the basket, when raised to cleaning position, will have a tendency to tilt the obstruction either into the basket or out of the way of the valve. This is due to the fact that the basket travels nearly its entire distance before the lower valve disc comes into contact with the lower seat of the valve collar.

The effective straining area of a Lagonda Strainer is from 2¼ to 4 times the area of the pipe line, and in removing one

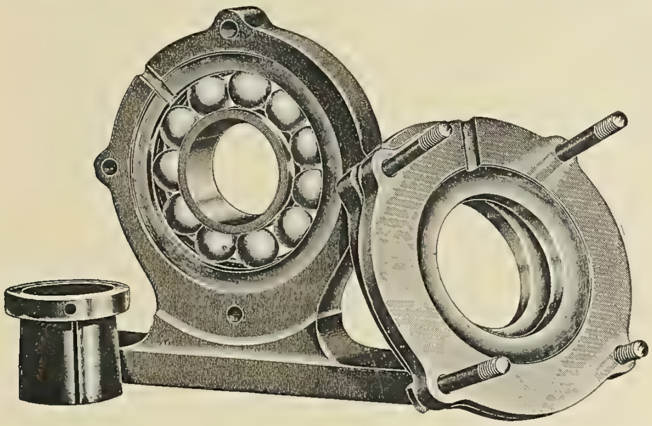
basket for cleaning the straining area is not reduced more than 30 percent; thus the pipe line is never throttled in the process of cleaning. In practice one of the baskets is left out of service, so that in case the baskets in use should become clogged the clean basket can be quickly lowered into service.

One important item concerning these strainers is that all of the internal parts subject to the action of water are made of bronze to eliminate troubles from corrosion. No leather or rubber washers are used.

Lagonda multiple strainers are built in sizes from 2 inches to 48 inches, having two to six baskets, the number depending upon the size of the strainer. They are also suitable for use in either suction or pressure lines, and are built to stand working pressures up to 200 pounds per square inch.

A Ball-Bearing Pillow Block.

The Bantam Anti-Friction Company, Bantam, Conn., have on the market a type of ball-bearing pillow block which is designed for excessive or high speeds. The illustration shows the partial disarrangement of the block, with the plates removed, bringing to view the ball races, method of oiling and

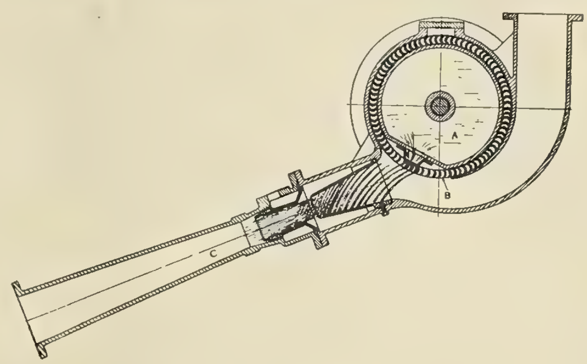


the clamping arrangement of the inner spool to the shaft. The races are made not of so-called tool steels, but of high-grade close-fiber machinery steels, carefully and well converted. The use of this grade of steel is a point for which the manufacturers have stubbornly fought for the last 12 years as being correct, and it is now interesting to learn that German manufacturers and engineers are accepting the same views.

The Westinghouse-Le Blanc Condenser.

The importance of obtaining a high vacuum with turbine engines has caused unusual attention to be given during the last few years to condensing apparatus. One development in this direction is illustrated herewith. It is known as the "Le Blanc" air pump and can be applied to an ordinary surface condensing plant, or in connection with a special type of jet condenser.

The principle on which this pump works is the use of a jet of water to remove the air from the condensers and compress and eject it against atmospheric pressure. The pump uses water moving at high velocity. The water is mechanically divided into successive layers, which entrain large volumes of air between them. These layers of water can be duly regarded as successive water pistons, each driving before it a charge of air. Referring to the section of the air pump illustrated: assuming that a vacuum has been established in the condenser, the water will flow from the chamber *A*, which is connected to the source of injection, into the turbine wheel *B*, which is running in a vacuum. This wheel literally pairs off thin layers of water, which are projected downwards through the diffuser *C*, and the interstices between these layers are filled with air. The pump impeller is driven by either an electric motor or a steam turbine on the same shaft, and usually there is connected to the other end of the shaft a centrifugal circulating pump. The impeller of the air pump is

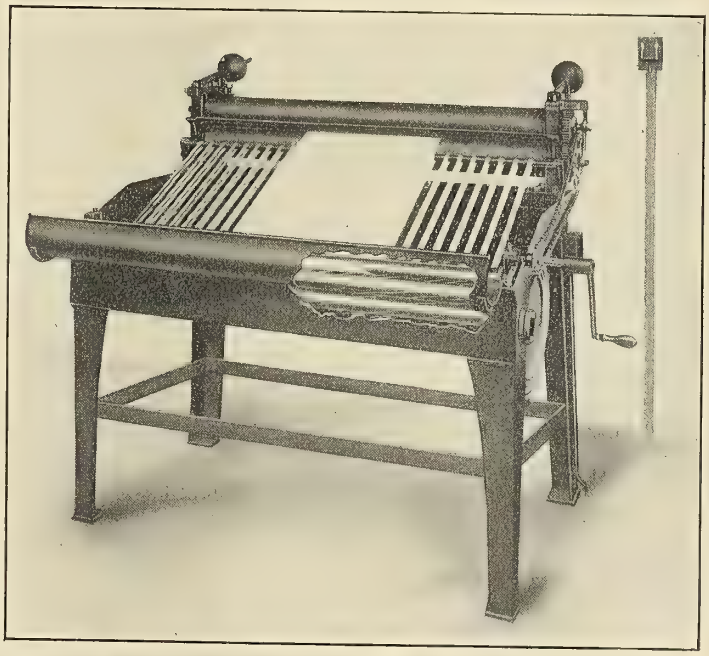


connected to the shaft and its rim is composed of a bronze ring furnished with blades. These blades are of cast bronze and are cast into the flanges which hold them, so that the completed ring is one piece of bronze.

The Mechanigraph.

The Mechanigraph is a machine which has just been placed on the market by Topping Brothers, 122 Chambers street, New York, which makes transparent and printable an opaque pencil or pen drawing at slight cost, thus enabling blue prints to be made from original drawings without the necessity of making tracings.

The machine consists merely of a series of electrically-warmed rolls; a chemical bath, also electrically warmed from the wire that warms the rolls; a series of traveling tapes, and



a pair of drier rolls. The whole machine, when set up ready to work, occupies a floor space less than 4 feet square. The operation consists merely in turning on the electric current, warming the rolls and bath, inserting the drawing, turning the crank and thereby running the drawing through the rolls, which press the chemical fluid into the drawing as it passes through. On leaving the rolls the drawing is conveyed by the traveling tapes to a pair of drier rolls, where the surplus

chemical is absorbed by surfacing paper inserted between the rolls. The drawing, therefore, comes from the machine practically dry, ready to be used for blue printing.

It is claimed that the mechanigraph makes any piece of white paper, no matter how heavy or opaque, transparent enough to blue print through quickly. The drawing may be made either in ink or pencil, as most convenient. It is claimed that there is no distortion or possibility of slip anywhere in the machine, so that the drawings are exactly the same as before being subject to treatment.

A further use of the machine is found in treating old and damaged tracings, which, it is claimed, may be made as good as new by passing through the machine.

TECHNICAL PUBLICATIONS.

Steamships and Their Story. By R. A. Fletcher. Size, 10 by 7 inches. Pages, 422; illustrations, 150. London, 1910: Sedgwick & Jackson. Price, 16/– net.

The above is a companion volume to "Sailing Ships and Their Story," which was reviewed in our issue for July. Mr. Fletcher has done his work well and the volume is a reliable reference book, dealing with a century's progress in the marine world. The volume is beautifully printed and replete with fine illustrations, which add considerably to the value of the book. It does the greatest credit to the publishers.

In a preliminary chapter, which covers 18 pages, the author deals with primitive experiments in propulsion. The next chapter covers the subject of the pioneers in steam navigation, where Fulton's work is fairly extensively dealt with. In another section Mr. Fletcher has given a short account of the foundation and early vessels of the various important steamship companies of this country. Then follows a section on railway companies and their vessels, and the opening of the transatlantic service. A chapter which is of special interest is one dealing with the development of steam auxilaries. Two chapters are devoted to experiments with iron shipbuilding and its development. The first of these has an excellent account of the *Great Britain,* and the latter some notes on the *Great Eastern.* The remaining three chapters are given up to discussions upon the more modern craft, and deals in addition to turbines with steam power and the navy, and the concluding chapter is upon miscellaneous vessels, in which the author discusses tugs, cargo boats, floating docks and eccentricities of design.

Mr. Fletcher has spared no pains in his research, and the result is a standard history of the steamship, which is extremely welcome.

Self-Taught Mechanical Drawing and Elementary Machine Design. By F. L. Sylvester, M. E., with additions by Erik Oberg. Size, 5 by 7½ inches. Pages, 333. Illustrations, 218. New York, 1910: Norman W. Henley Publishing Company. Price, $2.

A common fault with many text-books is that they are too advanced or theoretical to be of use to a practical mechanic, and when it comes to the selection of a suitable book for the man who has little or no knowledge of theoretical principles it is a difficult matter to find one which will answer his purposes. It is this lack of a suitable elementary book in mechanical drawing that has led to the publication of the work under review. The author has kept his aim well in view throughout the entire work, and it is primarily and essentially an elementary treatise and, as such, can be heartily recommended to practical men who wish to gain some knowledge of mechanical drawing and the common calculations necessary for machine design.

Reed's Drawings of Marine Turbine Engines. By W. T. Thorn. Size, 24 by 79 inches. Plates, two. Sunderland, 1910: Thomas Reed & Company, Ltd. Price, 3/6 net.

Since the steam turbine has come into general use for the propulsion of ships, every marine engineer should become familiar not only with the principles of operation, but with the design and construction and names of the various parts of these engines. These two sheets of drawings, which are of large size, show plainly the various details of a marine steam turbine, and an accompanying index gives the names of the various parts, so that they afford an excellent means of instruction in the details of a steam turbine.

Blue Book of American Shipping, 1910. Size, 7 by 9¾ inches. Pages, 611. Illustrations, 6. Cleveland, 1910: Penton Publishing Company. Price, $5.

As this is the fifteenth annual edition of this publication, it is hardly necessary to explain its main features, which are in general the same as in the previous editions. It contains the usual lists of American steam and sail vessels on the Atlantic and Pacific coasts, and rivers, and on the Great Lakes, and a list of vessels on the inland waters of Canada. The lists include such information as gross and net tonnage, principal dimensions, date of construction, name and address of owner or manager. There are also tables giving a list of the members of every important marine association or society in the United States, lists of the principal ship and engine building companies, various government officials connected with shipping and, finally, considerable information regarding the nature and volume of the water-borne traffic of the Great Lakes. The quantity and diversity of the data contained in the book make it an extremely valuable and useful book of reference.

Motor Control. By Andrew Olsson. Size, 5½ by 7¾ inches. Pages, 23. Diagrams, 5. New York, 1910: D. Van Nostrand & Company. Price, 50 cents net.

This is a brief manual comprising the first of an electrical series intended for use as text-books by students of the United States navy electrical shchools. The author has had a long service in the teaching corps of these schools, and is, therefore, enabled to present the matter in a highly practical form. The book deals only with the system of motor control used in connection with turret-turning and gun elevating, and is confined to a discussion of the Ward-Leonard system.

Hydrographic Surveying. By Commander Stuart V. S. C. Messum. Size, 5¼ by 7½ inches. Pages, 504. Figures, 262. Plates, 22. London, 1910: Charles Griffin & Company, Ltd. Philadelphia, 1910: J. B. Lippincott Company. Price (American edition), $3.75 net.

While most coast-surveying work is done by a fully-equipped surveying ship, commissioned for that purpose, there is still opportunity for beginners, seamen and others interested in the subject to make surveys of little-known parts of harbors and coast line, and to enable such observers to do this work with a fair degree of accuracy it is necessary that they should have a comprehensive knowledge of the use and limitations of the various instruments used, together with a complete understanding of the methods employed in such work. The author attempts to fill the need for a practical handbook for this work, and give such information as will enable the beginner to report intelligently and correctly to the proper authorities the changes that are occurring in the harbors, rivers, etc., and also to instruct those who are sufficiently interested to carry out original work along these lines. The first part of the book deals in great detail with all the instruments used for this work. Numerous illustrations and diagrams aid materially in explaining the text. The remainder of the book is divided into two parts, one of

which deals with projections and scales of charts and plans; and the other, which comprises the greater part of the work, with practical instruction in nautical surveying.

Fighting Ships, 1910. By Fred T. Jane. Size, 12 by 7½ inches. Pages, 525. Illustrations, about 500. London, 1910: Sampson Low, Marston & Company, Ltd. Price, 21s. net.

As a valuable book of reference regarding naval matters, this publication is in a class by itself. No other book uses so many or such excellent illustrations of the various warships of the world, both large and small, nor gives such complete details regarding the design and performance of these vessels in such clear and readily accessible form. This is the thirteenth year of issue, and, while the previous issues have been amply illustrated, this year's volume is notable in the number of new photographs, new plans and new silhouettes given, showing changes which have recently been made in existing warships.

Accuracy, of course, is an essential feature of such a book, but where the informtaion must be gathered from sources so diverse, and where, in general, every attempt is made to keep secret the details of new construction, it is no wonder that slight inaccuracies and discrepancies should be found. Interesting particulars are given regarding the newest ships under construction, particularly those of the German, British and South American navies. While the accuracy of these details cannot be vouched for, many of them, until this book appeared, were unknown to the majority of naval men.

As usual, a few pages in the back of the volume are devoted to timely articles by well-known authorities on naval matters, chief of which is one by Commander Hovgaard on the "Future Development of the Sea-going Battleship," in which the importance of the submarine in future naval warfare is emphasized and present battleship design is modified to provide protection against this method of attack.

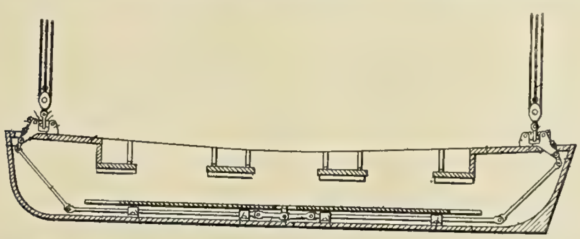
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

955,163. RELEASING DEVICE. CHARLES HUNT, OF NEW YORK, N. Y.

Claim 1.—A releasing device for boats, comprising a frame for attachment to a boat; a holding bar journaled on the frame and adapted to hold a member of the launching tackle; a locking-block co-operating



with said holding bar; a releasing lever pivoted at one end to the locking block and its other end co-operating with said frame; and means for actuating said releasing lever to release the holding bar. Four claims.

957,820. BOAT. HARVEY WEBSTER VANIMAN, OF CINCINNATI, OHIO.

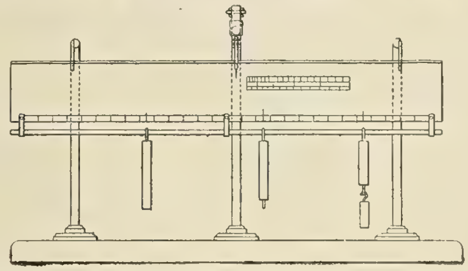
Claim 1.—A boat comprising a plurality of sections, each section being formed of sheet material bent to form a bottom and sides, and ends secured to the ends of the sides and bottom, angle plates connecting the ends to the sides and bottom, a reinforcing bar on the free edge of each side, a pair of angle plates on the under face of the bottom of each section and longitudinally of the boat, a bar arranged between the angle plates and connecting the sections, bolts traversing the bar and the angle plates, bolts connecting the ends of the adjacent sections, sundry of said sections having false bottoms, air chambers arranged between the said false bottom and the true bottom, said sections decreasing in size from the central to the end sections whereby to permit them to be arranged in nested relation, means for securing the sections together when so nested, and detachable handles connected with sundry of the sections. Three claims.

958,108. PROPELLER. GIUSEPPE GAYS, OF LOS ANGELES, CAL.

Claim.—An improved propeller having a plurality of spiral members or blades, the inner portion of each of which overlaps the inner portion of each of which overlaps the inner portion of each of the others; said spiral members or blades having varying thrust areas or operative superficial dimensions and being of the same pitch, each of said members extending approximately through 180 degrees of a circle; the outer edge portions of said spiral members or blades projecting radially and obliquely from the axis of the propeller; and said outer edge portions overlapping respectively the thrust areas of the adjacent members or blades. One claim.

958,192. DEVICE FOR DETERMINING THE METACENTRIC HEIGHT OF VESSELS. EDWIN TATE AND JEREMIAH MATTHEWS GOODALL, OF LONDON, ENGLAND.

Claim 1.—A device for determining the metacentric height of a vessel in any condition of loading, comprising a laterally movable beam, the length of which corresponds to the depth of the vessel and the weight of which represents the weight of the vessel in light condition, said beam being marked to scale with the positions of the centers of the cubic capacities of the holds for stowage of cargo, etc., and the



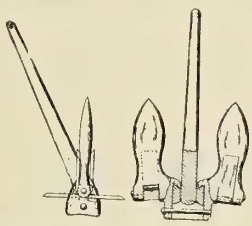
position of the transverse metacenter with the deadweights corresponding thereto, detachable weight movably suspended from said beam, and weights representing the deadweight carried by the vessel, side davits serving normally to support th beam, an intermediate davit and a lever carried by said intermediate davit on which said beam is adapted to be balanced. Three claims.

960,479. LIFE BOAT. JOHN E. ALLEN, OF VANCOUVER, BRITISH COLUMBIA, CANADA.

Claim 1.—In a marine vessel, the combination with the hull proper, of wing members disposed longitudinally and exteriorly of said hull, and downwardly and outwardly inclined partitions within said wing members to respectively divide the same into a plurality of compartments, each of said compartments having the outer wall thereof concavo-convex in contour. Two claims.

961,095. ANCHOR. WILLIAM M. BATEMAN, OF PHILADELPHIA, AND JAY C. LEVETT, OF CHESTER, PA.

Claim 2.—An anchor comprising a crown piece, flukes on the crown piece, a shank pivotally secured in the crown piece, said flukes having



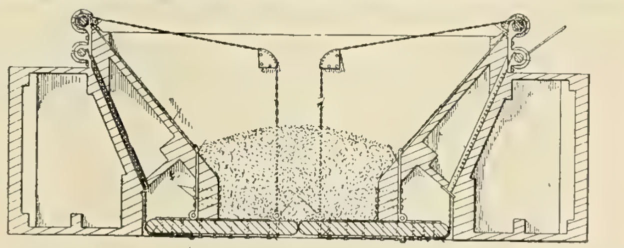
recesses in their ends, pins across said recesses, and angle floats pivotally supported on said pins. Four claims.

961,750. HIGH-SPEED BOAT. JOHN H. BRANTH, OF NEW YORK, N. Y.

Claim 3.—A boat comprising a hull the bottom of which is substantially horizontal in cross section and the bow of which is curved upwardly, the side portions of the hull being provided with longitudinally ranging downwardly directed keel-fins, and means for propelling the boat comprising a motor mounted therein, a propeller shaft connected therewith and passing downwardly and backwardly through the bottom of the hull of the boat and provided at its rear end with a propeller, the opening in the bottom of the hull through which the propeller shaft passes being inclosed by a hood which extends upwardly and forwardly to or approximately to the top of the hull. Six claims.

962,706. SCOW. CHARLES E. FOWLER, OF SEATTLE, WASH.

Claim 1.—A float having a cargo compartment, a door for said compartment arranged to swing outwardly beneath the water, and means



secured to said door and projecting on the opposite side of the point of swing thereof for applying force to move the door outwardly. Six claims.

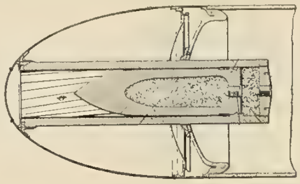
961,459. LIFE RAFT. WILLIAM S. RAY, OF SAN FRANCISCO, CAL., ASSIGNOR TO W. S. RAY MANUFACTURING COMPANY, OF SAN FRANCISCO, CAL., A CORPORATION OF CALIFORNIA.

Claim 1.—A life raft comprising parallel hollow cylinders each

formed with parallel horizontal flanges along its inner side, a diaphragm extending horizontally across each of the cylinders and dividing the same into upper and lower compartments, said diaphragm extending through the inner side of the cylinder between the horizontal flanges of the latter, and secured to said flanges, and connections between the cylinders. Ten claims.

964,147. TORPEDO. CLELAND DAVIS, OF THE UNITED STATES NAVY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO NATIONAL TORPEDO COMPANY, OF NEW YORK, N. Y., A CORPORATION OF MAINE.

Claim 1.—In a torpedo, the combination with the shell thereof, of a gun barrel fixed to the same adapted to fire a projectile therefrom, and



means forming a fixed and rigid part of said shell adapted to exclude water from said barrel. Ten claims.

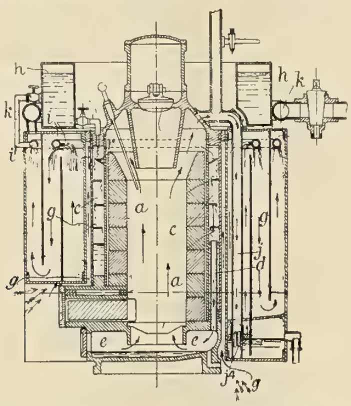
964,042. DREDGE-BUCKET. WILLIAM JOHN MOORE, OF VANCOUVER, BRITISH COLUMBIA, CANADA.

Claim 1.—A dredge comprising in combination, a water-tight bucket pivotally connected to the dipper arm of a dredge, a latch for securing the bucket against rotation on its pivots, means for holding said latch in a set position, and means governed by the movement of the bucket for releasing said holding means to permit said latch to latch the bucket against rotation on its pivots. Five claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

9,468. GAS PRODUCER PLANTS PREFERABLY FOR USE ON SHIPBOARD. A. W. WITHERS, LONDON.

In this apparatus the water supply tank and scrubber surround the furnace so as to form a unit, and there is a float for retaining the liquid seal during oscillation. Air passes up space *g* and enters vaporizer *c* at *x*. Here it is heated by radiation from the furnace *a* with water



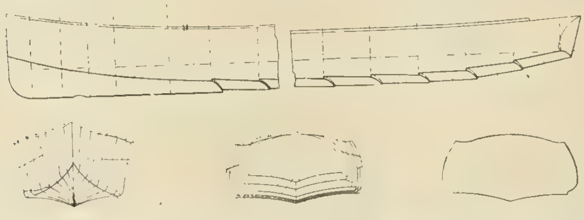
from tank *h*, and trickling over shelves then the air and vapor pass down pipes *d* through ashpit *e* and furnace *a*, where they become a gas, which leaves by pipe *j*, entering the scrubber at water-seal j^4. Here it is washed by jets from pipes *i* i^1, and issues for use from pipe k.

10,925. COMPASSES FOR PREVENTING ERRORS OF STEERING, AND INDICATING THE COURSE. L. NICHOLAS, WALTHAMSTOW.

The invention relates to a course indicator carried upon the compass card and moved to and set at any desired point. It is light, rigid, nonmagnetic, accurately belanced and rests upon or about the nave of the card, only touching it there so that it revolves with it, but can be raised and turned about to any point. The object is to prevent erroneous alteration of the course, a very common cause of many disasters.

12,107. HYDROPLANE BOATS. W. H. FAUBER, NANTERRE, FRANCE.

Claim.—The operation of these boats is affected if they are exposed to waves. The bow becomes immerged and no force tends to reinstate it. This invention remedies this detrimental effect by constructing the



boat so that the surfaces of the bow form a greater longitudinal angle than that of the hydroplane members proper. Another feature is the arrangement of the hydroplane members beneath the stern, so as to permit the water to flow in behind the boat and counteract the pressure of water on the bow. Another feature is the form of the hull at the bilge line to give the advantages of the rounded bilge without its disadvantage when applied to hydroplanes. The bilge and sides are rounded, the difference from ordinary boats being that an angle is formed, so that the water thrown sidewise from beneath the bottom flows clear of the side and air enters between the bilge and the water.

16,255. THE CONSTRUCTION OF COMBUSTION CHAMBERS OF MARINE AND OTHER BOILERS. THE NORTH EASTERN MARINE ENGINEERING COMPANY, LTD., AND S. HUNTER, WALSEND.

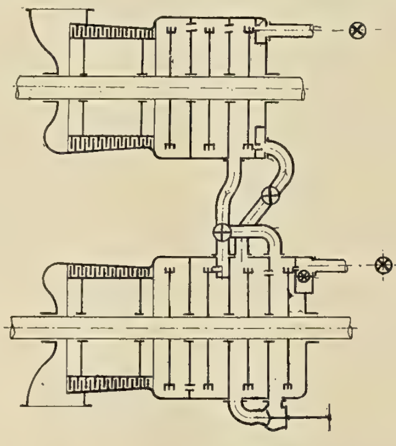
The improvements are in the wrapper plates of the chamber. The custom is to form the sides and top of the chamber of one plate of uniform thickness and the bottom of another plate of greater thickness. The inventors use only one wrapper plate. This is rolled with varying thicknesses. The thickest part forms the bottom of the chamber, and the thickness is gradually reduced to that of the sides. The single joint is arranged conveniently where it will be free from strains caused by expansion, contraction and bad circulation.

17,388. INDICATING A SHIP'S DEVIATIONS. W. H. HENNAH AND A. K. W. RISSEL, WELLINGTON, N. Z.

A stylus indicates upon a traveling strip the deviation of a ship from her course and sounds an alarm when the deviation continues for a set time or when a number of deviations aggregate, in time, this set period. The movement of the bowl round the card is used to close one or the other of two electric circuits that are both open when the card is in a central position. Each circuit, when closed, actuates a relay which completes a secondary magnetic circuit and so causes one of two clock mechanisms to move the stylus across the strip of paper to one side or the other of a line along it. The movement of the stylus a predetermined distance either way closes an alarm circuit and thus notifies a deviation.

23,312. TURBINE INSTALLATION WITH TWO SHAFTS FOR MARINE PROPULSION. AKT. GES. BROWN, BOVERI & CIE., BADEN, SWITZERLAND.

This is a two-shaft turbine installation for marine propulsion having partial impingment stages in which for normal power the turbines of each shaft work independently of those on the other shaft, while one or more additional stages are provided for smaller powers. These additional stages work in series connection with a portion of the stages for



normal powers, while the remaining stages are in parallel, and the cross-section areas for the nozzles are so chosen that they are, with series connection, sufficient for the total quantity of steam, and with parallel connection for half the quantity of steam. Thus the total number of additional stages necessary for decreased outputs or powers, as well as the number of manuvering of cruising devices to be actuated, are reduced.

25,781. DEVICES FOR PREVENTING OR LESSENING COLLISIONS. J. C. DE NEEF, ROTTERDAM, HOLLAND.

Claim.—The devices comprise side doors opening towards the stern and connected to the side by hinges and also by rods to a plunger enclosed in a cylinder within the ship, the rods pass through narrow openings in the hull of the vessel, so that in opening the doors, shock is avoided by the braking effect of the water which is being pressed by the plunger through the narrow openings. The cylinders are situated transversely of the ship, while the rods are entirely within the ship when the doors are closed. Latches engage hooks inside the doors and rods connect each set of latches and are lifted by chain gearing, after which the doors are opened partially by spiral springs. To lock the doors, drawing chains are wound up on the deck by a separate winch for each door, the latches being first lifted up by the hooks and then clasped in them.

29,661. LONG-DISTANCE SOUNDING MACHINE FOR SHIPS. A. CAPPELLINI. Commander in the Royal Italian Navy.

This invention is intended to provide a sea-lead for use in selecting a safe steerage in dangerous waters without decreasing the speed of the ship; 1 is a float having a recess for containing any suitable material for signals, such as calcium phosphide, and to this float a conical piece (3) with helical wings (4) is attached. At the point of the cone is a screw-threaded rod (5), and it turns in a nut (6), sliding in a guide forming a part of the bottom piece (2), which is so shaped as to not interfere with the operation of the screw (4) and to prevent rotation of piece 2. The apparatus is thrown from the ship in a case by a rocket or other means in the direction in which it is desired to effect soundings. On falling into the water the case opens, thus dropping the lead, which in its descent moves with a speed causing the screw to be rotated and unscrew the rod from the nut. Within the apparatus a graduated scale is provided for setting the apparatus for a depth necessary for the safety of the vessel. As soon as the rod 5 is unscrewed, piece 1 rises and indicates that there is the depth required. If the depth is less than that required and the apparatus touches bottom too soon, unscrewing of rod 5 stops prematurely, owing to interruption of the descent. The apparatus then remains assembled and submerged, and no signaling appears at the surface.

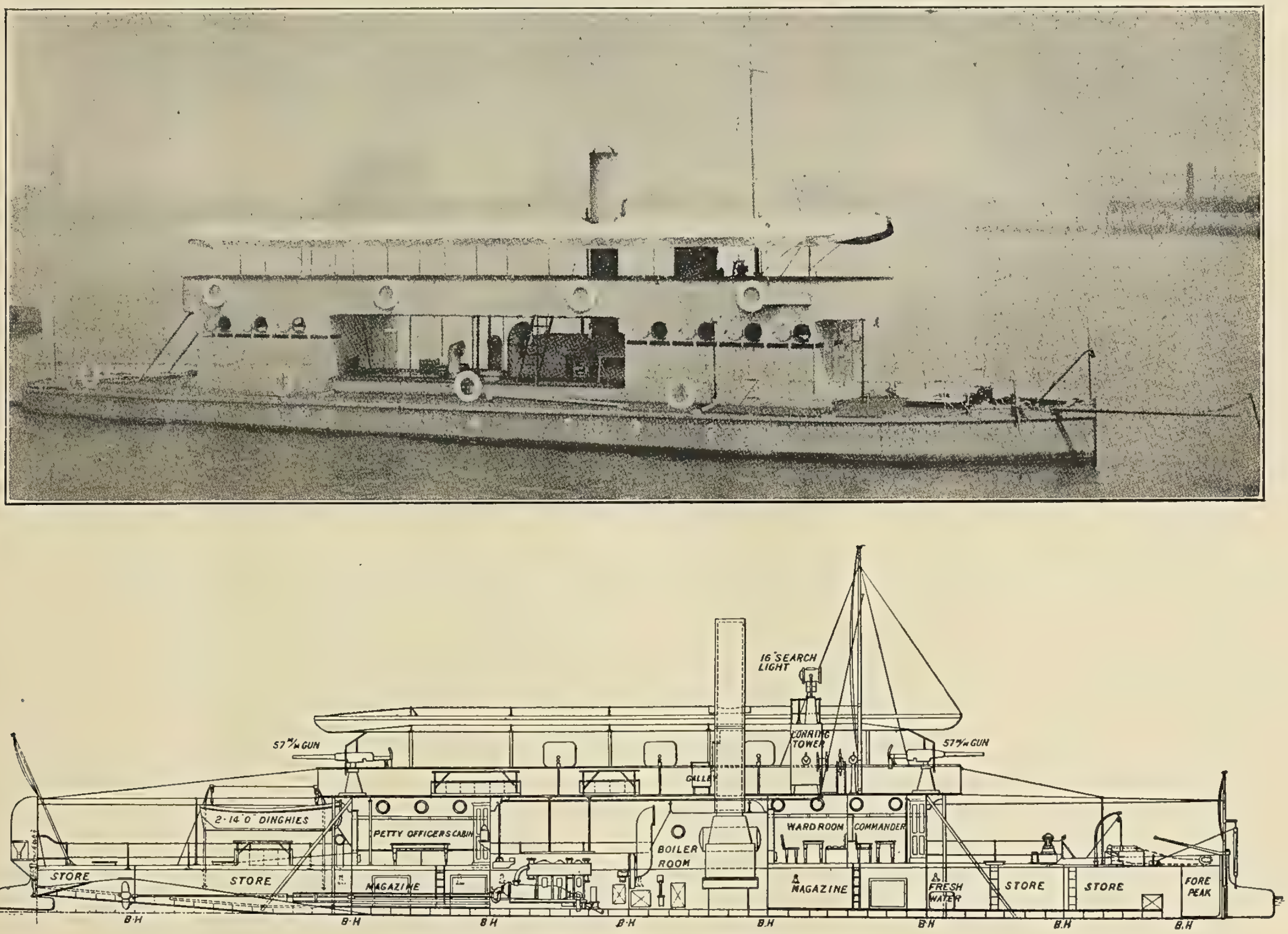
International Marine Engineering

NOVEMBER, 1910.

SHALLOW DRAFT GUN BOAT.

Yarrow's system of propulsion for shallow draft boats, consisting of twin screws, working in tunnels fitted with patent hinged flaps, by means of which the maximum efficiency of propulsion is obtained under all conditions of load, has been adopted in the construction of a new gunboat for Macao, a province in one of the Portuguese colonies in China. As the vessel is to be used for revenue service, it must be able to steam in the shallowest waters which are found in that district. The vessel was built by Messrs. Yarrow & Company, of Scotstoun, Glasgow, of the following dimensions: Length, 120 feet; beam, 20 feet; depth, 4 feet 9 inches; speed, at a draft of 25 inches with a load of 25 tons, 12½ statute miles per hour.

The hull is divided into 9 compartments by 8 watertight bulkheads. The forward compartment is used as a chain locker; the second and third compartments as provision and store rooms; the fourth compartment as a magazine room for the forward gun; the fifth compartment as the boiler room; the sixth as the engine room; the seventh as a magazine for the after gun, and the eighth and ninth as store rooms. The officers' quarters are forward on the main deck and the petty officers' quarters are on the same deck aft. The machinery space and the officers' quarters are protected by bullet-proof steel plates, while around the battery deck, which is also the berth deck for the crew, there is bullet-proof protection. The sectional view and photograph, shown herewith, give a good idea of the arrangement of the boat. It will be noted that the battery deck is covered by a double awning and that sprinklers are installed above this. As the climate in which this boat is to operate is very hot, this system of cooling the



PHOTOGRAPH AND SECTION OF YARROW GUNBOAT FOR MACAO.

vessel has been adopted, as it has been shown by experience to be very effective.

Propulsion is by two triple-expansion, surface-condensing engines, operating twin screws placed in tunnels. Two rudders are fitted aft, one exactly in the center of each tunnel. Thus the rudders receive the full effect of the stream of water driven aft by the propellers and give the greatest maneuvering power. The maneuvering properties of the boat are further enhanced by the use of the Yarrow bow rudder. This rudder is so designed that the hand tiller can be unshipped when going ahead and the rudder turned around against the bow of the ship, so as to be completely out of the water. When it is desired to go astern, the rudder can quickly be dropped into the water and its full effect obtained for maneuvering the boat.

Steam is supplied by a Yarrow watertube boiler, working under forced draft on the closed stoke-hold system. The boiler is designed for either wood or coal fuel, and if desired the boiler can be operated under natural draft. Independent main and auxiliary feed pumps are supplied, and a feed water filter is installed to prevent grease getting into the boiler. Besides the usual auxiliary machinery, there is a steam capstan forward for working the anchor and both steam and hand steering gear are fitted.

The vessel is armed with two 2¼-inch semi-automatic Hotchkiss guns and four ¼-inch rifle bore automatic guns, so arranged that three can be fired simultaneously on one side. The vessel is lighted throughout by electricity and carries a searchlight on top of the conning tower.

After the vessel was delivered, speed trials were carried out over a measured course in Kowloon Bay, Hong-Kong, where a speed of 13.156 miles per hour was obtained under contract conditions.

The estimates for the United States naval appropriations during the next fiscal year will probably amount to $128,300,000 (£25,400,000).

NEW ZEALAND RIVER STEAMER.

An interesting type of shallow-draft passenger boat has been built by Messrs. Simpson, Strickland & Company, Ltd., Dartmouth. The hull is 91 feet long, 14 feet beam and 3 feet 6 inches deep, built of ⅛-inch plating on 1½ by 1½ by ⅛-inch frames 15 inches apart. Destined for shallow river work in New Zealand, the draft of water when fully loaded with cargo and passengers was only 13 inches, and, furthermore, the vessel has to pass through some rapids, and a speed of 14 miles per hour was necessary. She was built in sections, which were bolted together at Dartmouth to enable the boat to be tried. The trials being entirely satisfactory the sections were unbolted and sent to New Zealand for final erection.

(Photograph copyrighted by the New Zealand Government, Tourists' Dep't.)

STEAMER OHMA GOING UP THE NYAPORO RAPIDS, NEW ZEALAND.

In spite of the very high speed obtained on the trial of the boat, at certain periods of the year, the rapids have a speed in excess of the boat, and it was therefore arranged to have a strong steam winch on the forward deck with warping rollers over the bows, so that by means of a rope the boat could be warped over the rapids, the engines meanwhile going full speed. It is a very interesting sight to see this maneuver, and by permission of the New Zealand Government we are enabled to reproduce a photograph showing this boat passing through the Nyaporo Rapids; the exhaust from the winch being very conspicuous, and the appearance of the smoke issuing from the funnel is a good indication of what is being done in the boiler room.

The boat not only has ample room for cargo, but is fitted with cabin accommodation for passengers and has a large promenade deck covered by an awning.

The machinery is arranged amidships and consists of two sets of triple expansion engines with cylinders 6 inches, 9¼ inches and 14 inches in diameter by 7 inches stroke, the boiler being of the watertube type. The engines are capable of developing easily and continuously 250 indicated horsepower collectively.

NOTES ON AMERICAN RIVER STEAMBOAT PRACTICE.

BY CAPTAIN T. M. REES.

Naval architects and marine engineers who are not thoroughly familiar with American river steamboat practice frequently are at a loss to know where to obtain accurate information regarding the size of steamboats, tow boats and barges commonly used for transportation on the Western rivers of the United States, and equally obscure are many of the details regarding the manner of building and handling these boats. The design of American river steamers is based largely upon experience, and the following notes are the result of many years' experience in designing and building this type of craft.

First as to the size of steamboats and tow boats and barges used in transportation on the Ohio and Mississippi Rivers; light-draft, steel-hull steamboats, 120 feet long, 24 feet 6 inches beam and 3 feet 6 inches depth, with cabin accommodations, with two engines, 10 inches diameter, 4 feet 6 inches stroke, will carry 60 tons of freight and 5 tons of fuel on a draft of 3 feet of water forward and 2 feet 6 inches aft, at a speed of 12 miles per hour, with a steam pressure of 170 pounds per square inch. A boat 125 feet long, 26 feet beam and 4 feet 6 inches depth of hold, with engines 12 inches diameter, 5 feet stroke, will carry 150 tons of freight on a draft of 4 feet at the bow and 3 feet 6 inches at the stern, the speed being from 12 to 13 miles per hour. A boat 145 feet long, 33 feet beam and 4 feet 6 inches depth, with engines 15 inches diameter, 6 feet stroke, will carry 300 tons on a draft of 5 feet forward and 3 feet 9 inches aft, the speed in this case being approximately that of the foregoing boats. A boat 170 feet long, 33 feet beam and 4 feet 6 inches depth, with engines 15 inches diameter, 6 feet stroke, traveling at a speed of from 13 to 15 miles per hour, will carry 90 tons of freight, drawing 27 inches of water on an even keel. Fully loaded, it will carry from 450 tons to 500 tons. The draft given in the foregoing cases was with stores and passengers aboard, and the speed is from records given by the owners.

Boats of this type are built as large as 275 feet long, 50 feet beam and 8 feet depth of hold. The steamer *Paragon,* which was 265 feet long, 48 feet beam and 7 feet depth of hold, with engines 22½ inches diameter, 8 feet 6 inches stroke, has brought up the Mississippi River from New Orleans to Cairo 1,000 tons of freight on a draft of 5 feet 3 inches forward and 4 feet 9 inches aft, averaging 10 miles per hour against the Mississippi River current. The fuel consumption for twenty-four hours was 1,200 bushels of coal up-stream and 800 bushels down-stream. The total capacity of the boat was 900 tons.

The engines on the boats which have been mentioned are of the high-pressure lever poppet valve type, with adjustable cut-off.

The freight rate from Pittsburg to Cincinnati, a distance of 466½ miles, is 8 cents per hundred pounds on heavy freight, and light freight according to bulk up to 15 cents per hundred pounds. The rate to New Orleans, a distance of 2,200 miles, is 35 cents per hundred pounds up to 50 cents on light freight.

In connection with the figures for fuel consumption, it should be stated that the coal is not the first quality, being run-of-mine and slack coal. On tow boats, on long trips, the boats carry what fuel they can, and then have a fuel flat or two in tow, which are dropped off at different landings, where they are picked up on the return trip. The passenger and freight boats, on the other hand, carry sufficient coal to make the run between the different coaling points on the river where coal is stored and sold.

THE WILL H. ISOM, ONE OF THE LARGEST YUKON TOW BOATS.

TOWING COAL AND FREIGHT IN BARGES.

The following data regarding towing coal and freight in barges is taken largely from records supplied by the Monongahela River Consolidated Coal & Coke Company.

The barges used on the Ohio and Mississippi Rivers and their tributaries may be divided into two classes, namely, the coal barge and the freight barge.

Coal barges are known as gunwale barges. with a scow end. They are 135 feet length, 25 feet width and 8 feet depth, with a normal draft, when loaded to full capacity. of about 6½ feet. The cargo capacity is 550 tons. These barges are constructed chiefly of wood, the side gunwales are 6 inches and 7 inches in thickness, and the bottom and end planking 3 inches. The ends, or rakes, as they are called, are circular, extending back about 18 or 20 feet from the ends. In recent years steel is being adopted to a limited extent in the construction of these barges, which, of course, is very much more desirable than wood, and particularly so for use in a Southern or tropical climate.

The cost of a wooden barge of these dimensions runs from $1,800 to $2 200 (£370 to £450), depending upon the character of material or workmanship. A steel barge of light dimen-

sions would run from about $5,500 to $6,000 (£1,130 to £1,230).

In past years, freight barges have usually been built of wood, with "model" ends, so as to make them tow easily against the current. Their carrying capacity runs from 750 tons to 1,400 tons, and the draft varies from 6½ feet to 9 feet. They cost from $5,000 to $25,000 (£1,030 to £5,140), depending upon the size, character of construction, etc. The tendency now seems to be toward steel for this character of craft, and this is certainly to be recommended for Southern climates and where the facilities for dry-docking and repairing are not so good as they are at Pittsburg. The annual depreciation on a wooden barge is from 7½ percent to 10 percent of its original cost. The question of repairs is a very difficult one to estimate accurately. For instance, during the first five years a wooden barge does not require very many repairs. Thereafter the repairs become very extensvie and expensive. A fair estimate for the average repairs on a wooden coal barge during its normal life is about $200 (£41) a year.

The manner of towing on the Ohio and Mississippi Rivers is unique. The barges are placed in front of the tow boat, the tow being made up in the form of a raft. Two barges are hitched on either side and forward of the tow boat, lapping over the tow boat a distance of about 40 feet or 50 feet, leaving an open space in front of the tow boat for the remaining length of the barges, which are hitched alongside. Then forward of these four barges and the towboat are hitched additional tiers of barges, usually from five to seven in width, and with from three to four length of barges. By means of ratchets and chains they are all bound closely together, forming practically one boat.

The transportation is carried out on what is commonly called "rises" in the river, or, in other words, freshets. The tows are prepared by having the barges loaded and moored at Pittsburg until there is sufficient stage of water caused from rains or melting snows, when the tows are hitched up and sent down the river to their destination. Since the major portion of the barges are returned empty that can be accomplished on a much lower stage of water than is required for carrying the loaded barges down-stream. The average current is usually from three to six miles per hour, depending upon the stage of water and the particular location on the river.

The size of the tows handled by these tow boats varies greatly, depending upon the stage of the water and the particular part of the river. For instance, an average tow from Pittsburg to Louisville, Ky., consists of about seventeen to twenty-four barges, say from 8,000 tons to 12,000 tons; while an average tow from Louisville, Ky., to New Orleans, on the Mississippi River, ranges from twenty-eight to forty-six barges.

The cost of transporting coal from the mines at Pittsburg to Louisville, Ky., a distance of about 650 miles, including all expenses, maintenance, repairs of craft, etc., is about 80 cents (£.164) per ton of 2,000 pounds. The cost of transporting coal from the mines at Pittsburg to New Orleans, a distance of about 2,000 miles, including all expenses, maintenance, repairs of craft, etc., is about $1.80 (£.37) per ton.

There is also a cheap coal boat of 2½-inch hemlock, 175 feet long, 26 feet wide and 10 feet deep, which carries 1,000 tons. These barges are only used for one or two trips and are then sold. They cost from $800 to $900 (£164 to £185), depending on the size and construction.

The largest tow boats have taken down the river from Louisville to New Orleans from 54,000 tons to 56,000 tons, including their fuel. This does not include the weight of the timber in the barges. These boats will bring up the river, against the current, 2,500 tons to 3,500 tons of freight at a speed of from 4 miles to 5 miles per hour on a 6½-foot or 7-foot stage of water.

Since the bulk of freight on the Ohio and Mississippi Rivers is down-stream, the barges for this service, with few exceptions, are not constructed with the easy rake for purposes of towing up-stream.

The tow boats have immense rudder power. Virtually the tow boat is but the rudder of the tow, as it is imposible to steer ahead constantly, owing to the danger of navigation, and the boats are constantly backing and flanking and putting the tow into shape to pass safely the bends in the river. It may be said that from Pittsburg to Cincinnati the engines on the tow boat may be backing one-fifth of the time. It is on account of the immense backing power of these stern-wheel boats that this type of steamboat has been so successful in inland navigation. There is no boat of any design that can compete with the stern-wheel boat in a river where there is a strong current and navigation is as hazardous as it is on the Ohio and Mississippi Rivers, which contain so many artificial obstructions, such as bridges, etc.

The number of the crew to operate these boats depends upon the service. For the small boats it requires two pilots, one acting as captain; two engineers, one mate, one watchman, two firemen, one cook and three deck hands. On the large boats there is one captain, two pilots, two engineers, four firemen, two cooks, one watchman, one mate, and from eight to twelve deck hands.

TOWING ON THE YUKON RIVER, ALASKA.

The manner of towing by barges depends upon the river and the amount of the traffic. On the Yukon River, Alaska, they tow both up-stream and down-stream, and also use a number of freight boats. The season is very short, commencing in June and closing in September. The largest, and one of the best, tow boats on the Yukon is the steamer *Will H. Isom*, 190 feet long on the deck, 36 feet beam, 6 feet depth of hold, 3 feet 6 inches sheer forward, 24 inches aft, having engines 24 inches diameter and 8-foot stroke, with five boilers, 40 inches diameter, 26 feet long. This boat is built of wood and cost $75,000 (£15,400); if built of steel she would have cost $100,000 (£20,500). Her draft is only 3 feet, to enable her to tow in from 3½ feet to 4½ feet of water. The engines are designed to work high-pressure condensing and also non-condensing, since they have to run in salt water. The fuel consumption is from 1,000 bushels to 1,200 bushels of coal per twenty-four hours. She is capable of towing up the river five barges with from 500 tons to 600 tons of freight in each, or, say, 2,500 tons in all.

The barges are 161 feet long, 38 feet beam and 7 feet 6 inches deep, with a cargo box to protect the freight. They are strongly built, to stand the rough water, and have a good rake forward and aft, extending about 20 feet from the ends. The rake starts about 2 feet down from the top of the gunwale. The scow model is used altogether. The draft, light, is 12 inches, and they carry from 150 tons to 160 tons per foot of draft. The load is varied, according to the season, depending upon the stage of the river.

The engines used for this service are mainly the lever-balanced high-pressure poppet valve type, with expansion joint side pipes, which is the simplest engine for the purpose, and it is designed to stand from 150 pounds to 250 pounds pressure. Outside of the wheel shaft, it is a very rare occurrence for one of these steamboats to be disabled by breakage of machinery. The cam motion for the cut-off and the connecting rod for full-stroke motion on all modern boats is now taken from the crosshead, and thus the danger of breakage of cams and connections on the wheel shaft is avoided.

It has sometimes been found essential on the boats used on very wide and shallow, swift rivers, like the Yukon, to place two small balanced monkey rudders aft of the wheel, as well as the main balanced rudders forward of the wheel.

SMALL TOW BOATS FOR USE ON THE MONONGAHELA AND OHIO RIVERS.

These boats range from 125 feet long and 20 feet to 22 feet beam to 140 feet long, and 24 feet to 27 feet beam and 3 feet 6 inches to 4 feet 6 inches deep, with engines ranging from 12 inches diameter by 5-foot stroke to 16 inches diameter by 7-foot stroke. The cost for a small boat of this type, with wooden hull, varies from $20,000 to $24,000 (£4,100 to £4,900), and for the largest from $32,000 to $35,000 (£6,570 to £7,200). Steel-hull boats, with a cabin frame of steel and tandem compound engines, 12 by 24 inches by 6 or 7 feet stroke, cost from $45,000 to $65,000 (£9,250 to £13,350). Boats of this latter type, built by James Rees & Sons for the Vest Coal Company, are 135 feet long, 26 feet beam and 4 feet depth of hold, with engines 12 inches by 24 inches by 6-foot stroke, tandem compound, with surface condenser. The wheel is 20 feet diameter, 16 feet wide, with buckets 36 inches wide, the average revolutions, when towing up or down-stream, being 17 or 18, with 160 pounds steam pressure and 26 inches vacuum. They tow five barges, with a capacity aggregating about 2,500 tons. The cost of towing is about 3½ cents per ton, and including all expenses for labor and repairs, insurance to boats and barges, it is about 4½ cents per ton. These boats can handle double the amount of tonnage, but, on account of the restriction of locks, that is all they are allowed to carry in a single tow.

The flats used by this firm are 100 feet long, 26 feet beam and 8 feet deep, with an 8-foot rake at each end. The cost of these barges is $2,600 (£535) when built of wood, and $5,250 (£1,080) when built of steel. The life of a wooden barge is about fifteen years, and the cost in repairs from $50 to $100 (£10 to £21) per year.

Both tow boats and barges for this service have to be exceptionally strong, as they must contend in winter with ice 8 inches to 10 inches thick. Also the machinery must be perfectly reliable, since they are operated in swift currents, where a single mishap is liable to send the boat over a dam.

SOME DATA ON PADDLE-WHEEL STEAMERS.

BY CLAUDE A. ANDERSON, S. B.

The information to be found on paddle wheels and the performances of paddle-wheel steamers is exceedingly meagre, and what there is rarely has the value of being up-to-date. Having need of more data than could be found in the best text books on naval architecture, the writer collected and compiled for his own use from every source reliable and possible to him what would give an idea of the best marine practice, both foreign and American. The table of figures accompanying this article contains the more complete results found.

As is well known by those who have sought information on the subject, the figures reported are notoriously often far from being actual. And it is with this knowledge that a great part of the data is presented—the writer not being responsible for errors due to false reports. Where variations have been noted for the same dimension, the one more apparently correct has been chosen; and where actual results have been given or the figures known to be correct through personal knowledge, an asterik has been placed opposite the name of boat under the heading "test." Most likely, however, the other figures are not in error to so great an extent but that they possess some value.

The boats chosen are selected as a representative lot, varying in size from the smallest to the largest in use, from the river and harbor excursion steamer to the Channel and the Lake night boats; and in nationality from the American to the English, French and Belgian.

The *Commonwealth* is the largest and latest addition to the Fall River line.

The *Priscilla* and the *Puritan,* of the same line, are also in the Long Island Sound service.

The *City of Cleveland* is the latest passenger boat of the D. and C. line, plying the waters of Lake Erie.

The *Providence,* also a Fall River line boat, runs between New York and Providence.

The *C. W. Morse* is in the Hudson river night service, between New York and Albany.

Hendrick Hudson is in the day line service between New York and Albany.

The *City of Erie* is the largest of the passenger steamers, making nightly trips between Cleveland and Buffalo.

The *New York,* burned to the water's edge in October, 1908, was also of the Hudson River Day line.

The *Tashmoo* is a fast excursion steamer, making daily trips on the Detroit and St. Clair rivers.

The *Jamestown* was built at the time of the Ter-Centennial, to carry passengers between Washington, D. C., and Norfolk, Va.

The *Middlesex* and the *Maryland* are Southern river and harbor steamers.

The *Nantasket, Old Colony* and *South Shore* are three of the excursion steamers making hourly trips between Boston and Nantasket Beach.

The *Isle of Arran,* built by T. B. Seath & Company, of Rutherglen, carries passengers on the waters of the Clyde.

The French steamers comprise a group of Channel steamers built by French shipbuilders and owned by the Northern Railway Company of France.

The *Paris* is a notable example of passenger steamer, built by A. & J. Inglis, of Glasgow.

The *Marie Henriette* is a passenger steamer for Channel service, belonging to the Belgian Government, and a product of the Cockerill Company.

The *Prince Rupert* is a Denny production for the English Channel service, but afterward transferred to Canada, where she now runs regularly between Yarmouth, N. S., and Digby.

Ville de Douvres, built by the Cockerill Company for the Belgian postal service between Ostend and Dover, was one of the foremost examples of her type at the time of her debut.

The *Mary Powell,* while not a feathering paddle steamer, is, nevertheless, included in the list as a boat possessing remarkable qualities as to hull, speed and general performance.

The *City of Alpena,* with her sistership, *City of Mackinac,* is a Lake boat from the design of Mr. Frank Kirby, and follows a course between Toledo, Ohio, and Mackinac Island.

The last example given is one of thirty boats built to the order of the London County Council for passenger trade on the Thames. Some of these boats were built by Thormycroft, but the one here given, and the fastest of the group, was built by Napier & Miller. Essentially river steamers, they have seaworthy qualities and are exceptionally interesting because of the small diameter of their wheels and the high number of revolutions.

As to results and purposes, the table speaks for itself in making comparisons between representative boats of different designers; but a few explanatory notes should be made regarding certain of the results:

(*A*) The peripheral speed in each case is figured on the diameter at the centers of gudgeons, and the slip is figured on the same circle.

(*B*) In the cases of the *Priscilla, Puritan, City of Cleveland, Providence, C. W. Morse, Jamestown, Maryland, Isle of Arran, Paris* and *Marie Henriette* the exact figure for the diameter to the centers of gudgeons could not be obtained, so was figured to be smaller than the diameter over buckets by 42½ percent the double width of one bucket.

(*C*) The block coefficient of the *City of Alpena* is figured for 9 feet 2¾ inches, the designed draft.

(*D*) The Admiralty coefficient $\left(\frac{D^{2/3}S^3}{I.\,H.\,P. \times 33{,}000}\right)$ is figured on knots—a figure which does not appear in the table.

For the *Commonwealth*, this coefficient is figured on a displacement of 5,430 tons corresponding to 13 feet ½ inch the measured draft on trial.

The displacement used in figuring the Admiralty coefficient for the *Priscilla* is 4,550 tons, she being presumably on light draft when she made 87¼ miles in three hours and fifty-seven minutes on 23.6 revolutions per minute and 9,000 horsepower.

For a coefficient expressing the relation between the work done on the water by the paddle and the horsepower developed at the engine, the quest has settled back to the expression given in some of the works on marine engineering, viz., $K = \frac{A\,R^3\,D^3\,N}{I.\,H.\,P. \times 33\,000}$, in which A is the area of one bucket in square feet; R, the revolutions per minute; D, the diameter to centers of gudgeons or effort; and N, the number of buckets in one wheel. Of the different expressions suggested, invented, and appropriated from authorities for this coefficient, the one here given brings results of the least percent variation between the extreme cases. And so it has been chosen for the table.

The last column of results gives the relation existing between the aggregate paddle area of the two wheels and the cubic number of the hull, taking the length between perpendiculars, the beam and the draft, as the component parts of that number, the A and the N in the denominator representing area of one float and number of floats in one wheel respectively. Where the load and light drafts are both given, the mean is used in this expression.

A glancing survey of the table is sufficient to show that there is certainly a great difference of practice in the design of paddle wheels, but it is the opinion of the writer that not all the examples presented should be given the same measure of respect. It is a matter of experience that many wheels built have been designed in ignorance of that which would produce best results, some being admitted failures, while others, apparently successful, do not stand the test of close analysis, leaving a doubt as to what they might not have done by certain alterations. Such, for instance, is the case of the *Ville de Douvres*, whose paddle area is excessive, and the width of whose paddles is about 5 inches in excess, as was pointed out by former Chief Engineer of the United States Navy Isherwood, in his comments on the trial of that boat.

It is not the object of this article to go into a detailed analysis of the figures in the table, but rather to merely present the evidence in the case, leaving the reader to be his own judge as to the examples most worthy to be followed. Yet, in a general way, there are several observations which, it may not be entirely valueless to note, viz., (*A*) That the relation existing between displacement, speed and horsepower is practically the same for the small boat and the large steamer alike.

(*B*) That the figures would indicate that no well-designed wheel should contain more than one bucket for each two feet of diameter to the centers of gudgeons. All the large wheels follow out this practice, but most of the smaller ones show a tendency to increase the ratio; and to their own loss in efficiency, for with the exception of the *Prince Rupert*, they all make a showing inferior to the large wheels. It may be the contention of the designers of smaller wheels that one bucket for each two feet of diameter will not give sufficient bucket area in the water to transmit the horsepower; yet this boat (*Prince Rupert*), with only seven buckets on a diameter of 14 feet 3 inches, is often called upon to meet the severest conditions to wheels and machinery in her rough passage across the Bay of Fundy, and is most successful. Each bucket is, of course, made sufficiently large to give the proper immersed paddle area. A lesser number of buckets and a correspondingly greater area in each bucket might have produced far better results in the other small wheels than the table shows.

It may not be redundant also to remark that where a less number of buckets is used, just that much weight and cost is saved, to say nothing of the friction reduced by the elimination of one or more sets of moving arms, rods and pins in their bearings, and the curtailment of their resistance through the water.

(*C*) That from the table and from other miscellaneous information not given in the table, seven is conceded to be the smallest number of buckets practicable on a wheel for propulsion. Continuing in the observation of the preceding paragraph, this number would limit the diameter to centers of effort of buckets at 14 feet, which really seems to be the minimum limit for a wheel. Many wheels have, however, been built with a smaller diameter for reasons, such as of securing greater deck room or of reducing the weight overhung from side of ship, for mere appearance' sake and from absolute necessity, which wheels, of course, would not be expected to show such efficiencies as those designed with no limitations on size, and purely for efficiency.

(*D*) That the stroke of engine should not exceed 7/16 the diameter of wheels to centers of efforts.

The paddle wheel as a means of propulsion is one which undoubtedly will not for some time be entirely displaced by the screw, hydraulic jet or other means yet to be devised, and in view of the dearth of reliable data at hand relative to design and performance, it would seem not an unprofitable undertaking at one or more of our model tanks to make a series of experiments on such wheels. Certain firms have made tank investigations more or less extensive for their own benefit, and it will be recalled that in 1836 the French naval marine fitted up two war vessels, counterparts as to hull, boilers and engines, the one with radial wheels, the other with feathering, maintaining practically the same diameters, to ascertain by direct trial their comparative efficiencies. Various runs were made with the boats side by side, but separated sufficiently so that neither would have influence on the other. The outcome of these trials demonstrated the radial wheels to be 23½ percent more efficient economically than the feathering, but because of the incompleteness of the investigation and the fact that the aggregate paddle area of the radial wheel was two and one-half times more than the feathering, the results were not exactly what might be called satisfying; and at this date, especially when paddle-wheel design is more of a science, the results are held to be rather crude.

For a model tank investigation, the following subjects might be presented as a suggestive list:

1. With a wheel of fixed diameter to center of effort and the revolutions of engine constant, the effect on the speed of boat by each addition of one bucket to the wheel, beginning with seven and ending, say, with as many as there are feet in the diameter.

2. With the diameter to centers of effort fixed and the speed of boat kept constant, the effect on the horsepower and the revolutions by each addition of one bucket to the wheel, beginning with seven and ending with the same number as in No. 1 above.

The subjects 1 and 2 may seem to duplicate each other in the conclusions to be arrived at, for with one set of experiments tabulated the other set might be obtained approximately, but for the sake of satisfaction and of check, the investigation of the second set can hardly be considered superfluous and might prove highly valuable.

DATA ON PADDLE WHEEL STEAMERS.

Date.	Name.	Test.	Gross Tons.	O. A. L.	L. B. P.	Beam of Hull.	Beam Over Guards.	Depth at Side.	Draft.
1908	Commonwealth	*	5,980	455′ 2″	437′ 11″	55′ 0″	96′ 0″	22′ 0″	13′ 0″ light. 15′ 0″ load.
1893	Priscilla	*	5,398	440′ 6″	423′ 6″	52′ 6″	92′ 6″	21′ 6″	12′ 0″ light. 13′ 0″ load.
1888	Puritan	..	4,593	410′ 0″	403′ 6″	52′ 6″	91′ 0″	21′ 4″	....
1908	City of Cleveland	*	4,568	404′ 0″	392′ 0″	54′ 0″	92′ 6″	22′ 0″	....
1904	Providence	..	4,365	397′ 0″	378′ 6″ at waterline.	50′ 0″	88′ 0″	21′ 10″	12′ 0″
1902	C. W. Morse	*	4,307	430′ 0″	410′ 0″	50′ 6″	90′ 0″	14′ 6″	9′ 0″
1906	Hendrick Hudson	..	2,847	390′ 0″	380′ 0″	45′ 0″	82′ 0″	14′ 4″	8′ 0″
1901	City of Erie	*	2,498	324′ 0″	314′ 0″ on keel.	44′ 0″	77.2′	18′ 0″	10.29′ average.
1887	New York	*	1,974	350′ 0″	330′ 0″ on waterline.	40′ 0″	74′ 0″	12′ 3″	6′ 0″ top of keel.
1901	Tashmoo	*	1,344	308′ 0″	300′ 0″ on keel.	37′ 6″	69′ 0″	13′ 6″	8.29′ average.
1906	Jamestown	*	1,337	262′ 0″	250′ 0″	38′ 0″	63′ 0″	14′ 6″	8′ 6″ average.
1902	Middlesex	..	....	207′ 0″	200′ 0″	36′ 0″	59′ 0″	12′ 3″	6′ 6″ light. 8′ 6″ load.
1902	Maryland	..	891		180′ 0″	34′ 0″	55′ 6″	10′ 1″	4′ 10″ average.
1902	Nantasket	*	739	203′ 0″	....	34′ 0″	....	....	6′ 3″
1904	Old Colony	*	741	192′ 0″	183′ 6″	32′ 0″	58′ 0″	11′ 10″	6′ 3″
1906	South Shore	*	874	205′ 6″	200′ 0″	32′ 0″	56′ 0″	12′ 0″	6′ 6″
1893	Isle of Arran	..	....	210′ 0″	....	24′ 0″	47′ 0″	....	....
1898	French Steamers	..	1,700	....	338′ 0″	34′ 9″	68′ 3″	16′ 3″	9′ 0¼″
1897	Paris	..	....	292′ 0″	....	36′ 0″	65′ 0″	13′ 0″	....
1894	Marie Henriette	*	....	340′ 0″	....	38′ 0″	76′ 7″	15′ 0″	8′ 11¼″
1894	Prince Rupert	*	....	270′ 0″	....	....	....	....	9′ 0″
1890	Ville de Douvres	*	875	....	271′ 0″	29′ 0″	....	15′ 6″	9′ 0¾″ mean.
1861 1897	Mary Powell	*	983	300′ 0″	286′ 0″	34′ 4″	64′ 0″	....	6′ 0″
1893	City of Alpena	*	....	275′ 0″	266′ 0″	38′ 6″	68′ 0″	15′ 0″	8′ 11″
1905	London County Council	..	....	....	130′ 0″	18′ 6″	....	7′ 0″	2′ 9⅜″

Date.	Name.	Test.	Displacement.	I. H. P.	Speed in Miles.	Size of Buckets.	Area of Buckets.	Width ÷ Length Buckets.	Dip of Bucket.
							Square Feet.		
1908	Commonwealth	*	5,410 light. 6,410 load.	12,000 max.	23.09 max.	14′ 6″ x 5′ 0″	72.5	.345	....
1893	Priscilla	*	4,550 light. 5,030 load.	9,000 max.	22.09 max.	14′ 0″ x 5′ 0″	70.	.357	24″ light. 36″ load.
1888	Puritan	..	....	7,700 max.	21.625	14′ 0″ x 5′ 0″	70.	.357	....
1908	City of Cleveland	*	....	6,622	21.	14′ 0″ x 4′ 6″	63.	.321	....
1904	Providence	..	....	5,500	19. av.	13′ 0″ x 4′ 0″	52.	.308	....
1902	C. W. Morse	*	3,300	4,500	19.6 av.	12′ 11½″ x (4′ 6″) (?)	58.3	.347	....
1906	Hendrick Hudson	..	....	5,000	22.	16′ 6″ x 4′ 0″	66.	.242	....
1901	City of Erie	*	2,233	6,472	21.76	12′ 0″ x 4′ 0″	48.	.333	14″
1887	New York	*	1,240	2,650 av.	20.59	12′ 6″ x 3′ 4″	41.65	.266	13″
1901	Tashmoo	*	1,224	3,400	21.70	12′ 0″ x 3′ 9″	45.	.312	12″
1906	Jamestown	*	....	2,000	18.79	9′ 0″ x 36″	27.	.333	....
1902	Middlesex	..	725 light. 920 load.	1,300	16. light.	8′ 6″ x 36″	25.5	.353	18″ load.
1902	Maryland	..	....	....	15.	7′ 6″ x 36″	22.5	.400	....
1902	Nantasket	*	....	1,100	15.	8′ 11¾″x 32½″	24.35	.301	20″
1904	Old Colony	*	....	1,000	16. av.	8′ 9″ x 33″	24.1	.314	26″
1906	South Shore	*	630 At 5′ 6″ draft.	1,100	14.9	9′ 6″ x 36½″	28.9	.320	16″ about.
1893	Isle of Arran	..	....	1,300	16.5	9′ 6″ x 34″	26.9	.298	....
1898	French Steamers	..	....	7,000	24.8	14′ 1″ x 4′ 3″	59.9	.302	....
1897	Paris	..	....	2,200	18.42	11′ 6″ x 4′ 0″	46.	.348	....
1894	Marie Henriette	*	1,525	8,134	25.5	15′ 0″ x 4′ 4″	65.	.289	....
1894	Prince Rupert	*	....	2,609	20.	13′ 10″ x 3′ 9″	51.9	.271	14″
1890	Ville de Douvres	*	1,090	2,982	19.7	10′ 0″ x 4′ 4″	43.33	.433	17″
1861 1897	Mary Powell	*	800 about.	1,560	19.83	10′ 6″ x 17.7″	15.5	.1405	....
1893	City of Alpena	*	1,712	2,398	16.991	10′ 0″ x 3′ 6″	35.	.35	7″
1905	London County Council	..	....	360	14.1	....	10.	....	....

Date.	Name.	Test.	Area Below Center of Effort.	No. of Buckets.	Diameter to Center of Pressure.	No. of Buckets ÷ Diameter to Center Pressure.	Peripheral Distance Between Buckets.	R. P. M.	Peripheral Speed.	Slip.
										Percent.
1908	Commonwealth	*	.425	12	26′ 9″	.450	7.01	29.77	2,502	18.75
1893	Priscilla	*	....	13	30′ 9″	.423	7.43	23.6 max.	2,280	14.75
1888	Puritan	..	....	13	30′ 9″	.423	7.43	22.8	2,203	15.75
1908	City of Cleveland	*	....	11	25.2′ about.	.437	7.20	29.	2,296	19.5
1904	Providence	..	....	12	26.1′ about.	.460	6.84	....	....	....
1902	C. W. Morse	*	....	12	26.1′ about.	.460	6.84	27.	2,216	22.2
1906	Hendrick Hudson	..	....	9	20′ 6″	.438	7.17	40.	2,580	24.95
1901	City of Erie	*	.417	11	25′ 2″	.438	7.20	33.25	2,628	27.
1887	New York	*	.425	12	27′ 0″	.445	7.06	26.63	2,259	19.79
1901	Tashmoo	*	.445	9	19′ 1″	.471	6.67	40.08	2,403	20.5
1906	Jamestown	*	....	9	14.7′	.612	5.14	53.13	2,458	32.7
1902	Middlesex	..	....	9	13′ 2″	.683	4.61	45.	1,862	24.34
1902	Maryland	..	....	12	16′ 6″	.728	4.32	....	....	....
1902	Nantasket	*	.462	10	20′ 2¼″	.496	6.35	28.	1,776	25.56
1904	Old Colony	*	....	9	17′ 2″	.524	6 00	35.	1,890	25.5
1906	South Shore	*	.480	10	18′ 1″	.553	5.69	31.	1,764	25.65
1893	Isle of Arran	..	....	8	14′ 10″ about.	.539	5.84	46.	2,145	32.2
1898	French Steamers	..	....	9	19′ 0″	.473	6.64	52.	3,104	29.8
1897	Paris	..	....	8	17.6′	.455	6.92	32.	1,772	8.6
1894	Marie Henriette	*	....	9	18.65′	.482	6.52	52.8	3,096	27.4
1894	Prince Rupert	*	.45	7	14′ 3″	.491	6.40	43.	1,925	8.6
1890	Ville de Douvres	*	.423	9	19′ 2″	.470	6.70	36.82	2,217	21.78
1861 1897	Mary Powell	*	....	26	31′ 9″ diameter over buckets.	....	....	27. av.	....	....
1893	City of Alpena	*	.44	10	22′ 6″	.455	7.11	28.5	2,026	26.2
1905	London County Council	..	....	7	8′ 6″	.824	3.82	69.8	1,864	33.4

DATA ON PADDLE WHEEL STEAMERS—Continued.

Date.	Name.	Test.	Stroke.	Stroke ÷ Diameter to Center of Pressure.	Piston Speed.	Grate Surface.	I. H. P. / G. S.	Draft.	Block Co-efficient.	$S^{\frac{3}{4}}D^3$ / I. H. P.	K.	L × B × D / 2 A N.
1908	Commonwealth	*	9′ 6″	.355	566′	937.	12.82	....	.608	209.	1,110	193.6
1893	Priscilla	*	11′ 0″	.358	519′ max.	850.	10.59	....	.622 load .597	216.	1,170	152.5
1888	Puritan	..	9′ 0″ 14′ 0″	.2925 .456	....	850.	9.06	Natural	.611	......	1,233	......
1908	City of Cleveland	*	8′ 0″	.317	464′	....	....	....	......	......	1,241	......
1904	Providence	..	9′ 0″	.345	....	532.8	10.3	....	......	......	......	182.
1902	C. W. Morse	*	12′ 0″	.46	648′	320.	14.05	....	.637	242.	1,650	133.
1906	Hendrick Hudson	..	7′ 0″	.348	560	....	....	....	......	......	1,985	115.
1901	City of Erie	*	8′ 0″ 12′ 0″	.478 .318	532 H.P. 798 L.P	252.	25.68	Forced	.551	178.2	1,447	135.
1887	New York	*	12′ 0″	.445	640	228.	11.58	Natural	.548	251.	2,120	79.25
1901	Tashmoo	*	6′ 0″	.3145	481	294.	11.56	Natural	.463	225.	1,618	115.
1906	Jamestown	*	5′ 6″	.374	584	244.	8.2	Natural	......	......	1,754	166.
1902	Middlesex	..	7′ 0″	.531	630	130.	10.	Natural	.526 load	167.	1,111	117.5
1902	Maryland	..	9′ 0″	.545	....	91.	....	....	......	......	......	54.8
1902	Nantasket	*	9′ 0″	.446	504	....	....	Natural	......	......	1,210	......
1904	Old Colony	*	8′ 0″	.466	560	....	....	Natural	......	......	1 425	84.6
1906	South Shore	*	8′ 0″	.442	496	112.	10.7	Naturla	.629	......	1,260	72.
1893	Isle of Arran	..	5′ 0″	.337	460	130.	10.0	....	......	......	1,590	......
1898	French Steamers	..	7′ 4.58″	.388	768	516.	13.55	Forced	......	......	2,250	98.5
1897	Paris	..	7′ 0″	.400	448	140.	15.7	Forced	......	......	888	......
1894	Marie Henriette	*	7′ 0″	.375	740	465.	17.46	Forced	.461	178.2	2,075	......
1894	Prince Rupert	*	6′ 0″	.421	516	....	....	....	......	......	970	......
1890	Ville de Douvres	*	6′ 0″	.313	442	235.5	12.67	Forced	.50	177.6	1,391	91.3
1861 1897	Mary Powell	*	12′ 0″	....	....	156.	10.	....	.494	......	......	73.0
1893	City of Alpena	*	7′ 4″ 11′ 0″	.326 .489	418 627	160.	14.99	Forced	.576	191.5	1,167	131.
1905	London County Council	..	3′ 0″	.353	419	25.	14.4	Forced	......	......	1,231	48.1

3. It has been assumed in subjects 1 and 2 that the size of paddles have been kept all alike. For the third series of experiments let 1 and 2 be repeated, only with this change, that the aggregate paddle area shall be kept constant. Having decided on the proper area of paddle surface for a certain boat, this series ought to give the proper distribution of that area over the most efficient number of paddles.

4. With the same fixed diameter as in 1 and 2, say, and a given number of buckets, the effect of increasing the immersion of upper edge of bucket from zero to the width of bucket.

5. Having tabulated all the above results and plotted the curves corresponding; and possessing the information thus obtained of the proper number and size of buckets for that diameter of wheel to produce the highest efficiency, to compare this wheel with either a larger or a smaller one, the second wheel to be of a design embodying what, in these preceding subjects, has been shown to produce as near the perfect wheel as possible. This experiment would aim to show the relative benefits to be derived from the large wheel at a lesser number of revolutions and the smaller one at a higher number of turns.

The object of these tests would be, in short, to seek to standardize the paddle wheel; to make it possible for the engineer, confronted with a new proposition, to be able almost immediately to settle on the principal sizes of his wheel, and, having made this decision, to be able to rest reasonably assured that his efforts will not meet with anything other than approved success.

The following data regarding the *Bay State* of the Eastern Steamship Company is also available:

Date	1895
Gross tons	2,211
Length over all	292 ft.
Length between perpendiculars	281 ft. 3 ins.
Beam	42 ft. 1 in.
Beam over guards	72 ft.
Depth at side	15 ft. 6 ins.
Draft, about	7 ft.
Indicated horsepower	1,000
Speed in miles per hour	13.8
Size of buckets	10 ft. 8 ins by 3 ft. 6 ins.
Area of buckets	37.3
Width ÷ length of buckets	.337
Dip of buckets	14 ins.
Area below center of effort	.45
Number of buckets	11
Diameter to center of pressure	22 ft. 6¾ ins.
Number of buckets ÷ diameter to center of pressure	.488
Peripheral distance between buckets	6.42
Revolutions per minute	24
Peripheral speed	1,697
Slip	27.4
Stroke	12
Piston speed	576
Draft	Natural

$$K = 1{,}979$$

$$\frac{L \times B \times D}{2\,A\,N} = 104.8$$

In the *Bay State* is found an example of the old-style radial wheels displaced for the feathering wheels. The old wheels were 35 feet 8 inches diameter over the floats and turned 16 revolutions per minute on the average. The new wheels, 22 feet 6¾ inches diameter, to center line of gudgeons turned twenty revolutions on the average, but with only 40 pounds gage pressure on the boiler against 45 pounds with the radial wheels. No trial trip to determine the performance of the engine with the new wheels has ever been made, but it was observed on the first trip out (trial trip so-called) that she made the distance from Boston Light to the lightship (6 miles) in twenty-six minutes at 24 revolutions per minute. Upon this data the foregoing figures are based. The horsepower is an approximation based upon what is done under ordinary running conditions. It will be understood that the higher speed is not attempted with the new wheels, the distance from Boston to Portland, Me. (97 miles), being run in the same average time (9¾ hours) as before. The change in these wheels was made during the winter 1909-1910, and the design is that of the eminent naval architect Stevenson Taylor.

The Gebrüder Sachenberg Aktiengesellschaft, Rosslau, have built for the Venezuelan Republic the shallow draft stern-wheel steamer *Josefina*. This is a steel hull boat 108.4 feet long, 25.6 feet broad, fitted with two longitudinal and five athwartship bulkheads, dividing the hull into sixteen water-tight compartments. The hull is thoroughly braced with a system of hog chains, and above the main deck there are an upper deck and a shade deck with limited passenger accommodations. The boiler is located forward on the main deck. It is of the locomotive type, with a fire-box extending below the deck, and designed for a steam pressure of 155 pounds. The engines are located aft on the main deck, one on each side. The high-pressure cylinder is 14 3/16 inches diameter and the low-pressure 23 5/8 inches diameter, the stroke being 43 5/16 inches. The stern paddle-wheel has twenty-four wood buckets, each 9½ inches wide, 8 fet 8 inches long.

STERN WHEEL STEAMERS ON GERMAN RIVERS.

BY OUR BERLIN CORRESPONDENT.

On the Elbe and Oder Rivers, as well as on their tributaries, and the canals connected with them, there are in service a large number of what are called stern-wheel steamers, most of which are used as tugs, while some of them, known as express steamers, are set apart for the direct freight traffic.

The most important shipping companies running steamers of this kind are the Neue Oder-Elbe Reederei at Breslau, Emanuel Friedländer & Company at Zarkau, the Frankfurter Gütereisenbahn-Gesellschaft at Breslau, the Dampfer-Genossenschaft deutscher Strom's und Binnenschiffer at Fürstenberg on the Oder. In addition there are quite a number of stern-wheel steamers owned by minor shipping companies or individual captains.

The building of this type of vessel, which has at present reached a high degree of efficiency, has been developed especially by the following shipbuilding yards: Gustav Fechter, at Königsberg, in Prussia; Gebrüder Sachsenberg, at Rosslau on the Elbe; Cæsar Wollheim, at Cosel, near Breslau. The Cæsar Wollheim yards, especially, have turned out a number of stern-wheel steamers of late years. In addition to the foregoing firms, a number of smaller shipbuilding yards have likewise been building steamers of the same type.

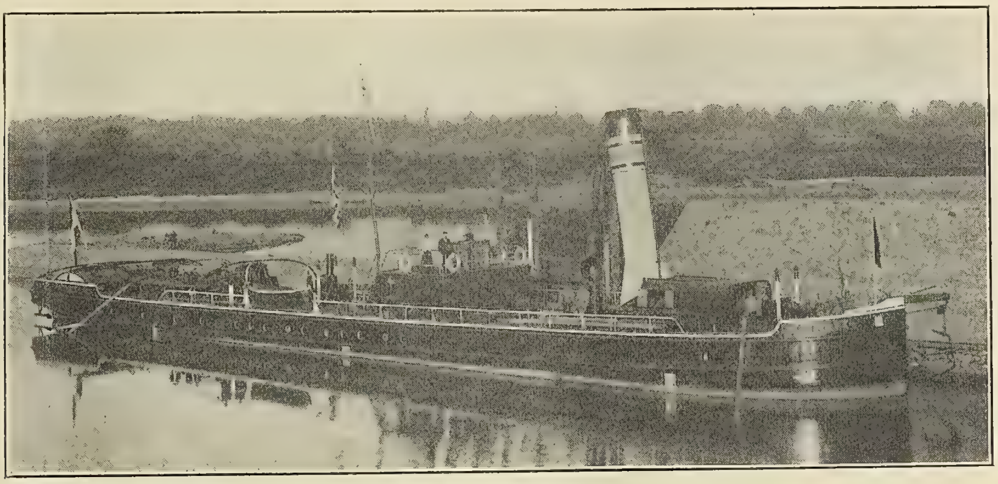


FIG. 1.

That the stern-wheel steamer has its right of existence beside the side-wheel and screw steamers, found in such large numbers on German rivers, is due to the special conditions of navigation there. The upper course of the Oder is regulated by sixteen towing stages, while numerous sluices are installed also between the Elbe and Oder Rivers and their tributaries. The possibilities of the screw steamer as a tug are limited on one hand by a slight depth of water, and on the other by a high rate of flow. Again, the side-wheel steamer proves too broad in the case of high-powered boats to pass through the sluices. While these two types of vessel are used extensively on the broad and relatively deep lower courses of those rivers, the stern-wheel steamer seems to be adapted, on account of its draft, width, length and engine capacity, to the special conditions of the sluices in the regulated river system, thus creating an extraordinarily convenient means of transport.

The latest vessels of this type are about 165 feet in length, 27 feet in width, 3 feet 3 inches in draft, and have engines of about 750 indicated horsepower. Beside these there are minor craft in various intermediary stages up to about 150 indicated horsepower. As regards the size of these vessels, the limits compatible with the dimensions of sluices have unfortunately been reached, as it is impossible to install more powerful engines in a hull of the above dimensions, and these dimensions may not be exceeded. It may be said in this connection that side-wheel steamers, with engines of 1,000 to 1,500 indicated horsepower, can be found on the Elbe, and especially the Rhine River, but these sizes are admissible only where there is a sufficiently deep and broad channel throughout the course of the river.

The type of stern-wheel steamer in question should not be confused with the craft of a similar kind which is frequently used outside of Europe; in fact, there are, in Asia, Africa, and especially America, thousands of stern-wheel steamers, the smallest of which are built to a large extent in Germany. In America there have been used for many years stern-wheel steamers of particularly huge dimensions and a capacity of 1,000 and more horsepower, but the difference between those steamers and the German craft under discussion lies mainly in the design of the engine plant and propellers.

Stern-wheel steamers outside of Europe have mostly relatively large wheels, with a number of stationary paddles of the arrangement originally adopted for paddle wheels. They are propelled by engines and boilers of the most simple and primitive construction, the boilers being frequently stoked with wood.

German steamers, on the other hand, are equipped with small, light, double-sectioned wheels and movable paddles. The latter are adjusted by means of a lever system, so as always to place the paddle surface vertically just outside the water, and to make immersion and emersion as smooth as possible. Furthermore, the paddles are curved vertically and accordingly are capable of getting a better grip on the water, while exerting a more satisfactory power effect than common radial paddles. This affords a means of securing, with a limited number of paddles and small light wheels, unusually high propulsive forces. These wheels are generally fitted with seven paddles as a maximum.

While this propeller design in itself improves the efficiency of the engine plant, a further improvement, both from a mechanical and economical point of view, is obtained by using the most up-to-date design of boilers and engines. The engines are compounded, and in the case of larger vessels even triple expansion engines, with three cylinders, are used, while the steam pressures are in keeping with this efficiency. Even superheating has been made use of. This accounts for the remarkable economical efficiencies and maneuvering capacities, coupled with a saving in weight and cost.

The cost of a stern-wheel steam tug of from 500 to 600 horsepower works out at about $30,000 to $40,000 (£6,200 to £8,200). As regards the efficiency of some recent boats of this type, the following figures have been given out regarding vessels constructed by Cæsar Wollheim at Cosel, near Breslau.

The steam tug *Altmark* (Fig. 1) plies mainly on the Elbe and Oder Rivers, and the main waterways connected to them. She is of about 35½ inches draft, and is capable of an output of about 490 indicated horsepower for towing purposes. This is sufficient to enable her to tow a train of sixteen empty barges, 5,000 tons in total weight, at a speed of about 2.7 knots, in fifty-nine traveling hours, from Fürstenberg to Breslau, while using up only about 23.5 tons of coal on this journey. The coal consumption per hour thus amounts o about 1.76 pounds for each horsepower.

The steam tugs *Saale* and *Imperator* (Fig. 2) travel mainly on the Elbe River, conveying on the Hamburg-Magdeburg line tows aggregating 3,260 to 3,750 tons in weight. Their coal consumption, with a 50 percent charge in the high-pressure cylinder, works out at about 1.72 pounds per indicated horsepower-hour, inclusive of the consumption corresponding to the steam rudder, etc.

The steamships *N. O. E. R. III.* and *Johanna*, traveling on the Oder River, with a coal consumption of from 1.76 to 1.81 pounds per horsepower-hour, have towed eight and more barges of about 2,200 tons from Stettin to Breslau, against rising middle water, at an average speed of 2.26 knots; the coal consumption including losses for the steam rudder, cleaning of the fires, etc. Coal of Upper Silesia is used for boiler stoking.

The following is a short description of a typical large-sized up-to-date German stern-wheel steamer:

The length between the stem and stern post is 165 feet 8 inches, the width on the frames 25 feet 10 inches, the maximum width above what are called the hawse-pieces 26 feet 10 inches, the height on the sides 7 feet 5 inches. The draft of the vessel in working operation, inclusive of the towing attachments, spare parts and 20 tons of coal on board, is about 3 feet, the highest fixed point lying 11 feet as a maximum above water.

The hull is made of first-class German Siemens-Martin ingot iron, the stem and stern post being made up of angle irons and plates. The rudder, about 16 feet 6 inches in length, is made of a welded frame, with iron plating and fir wood filling, and is actuated through chains and levers by a steam-operated steering engine, or by a hand-steering gear from the flying bridge.

The frames are made up of 2½-inch by 2-inch by 3/16-inch angles, spaced about 20 inches apart. In the fore-and-aft parts of the ship there are fitted reverse frames for reinforcing the structure. In addition there is fitted on an average to each fourth or sixth frame a web frame made up of plates about 8 inches in width and 5/32 inch in thickness, with 1¾-inch by 1¾-inch by 5/32-inch angles, continued as a complete frame also below the deck. The floor plates are 8 inches by 5/32 inch, on the upper edge of which are angles, 1¾ inches by 1¾ inches by 3/16 inch. In the boiler and engine rooms, the floors are properly reinforced in accordance with the greater weights. Deck beams of 2½-inch by 2-inch by ¼-inch angles are fitted to each frame. The longitudinal bond of the vessel is designed very carefully, so as to deal with the heavy weight of the boilers and engines located at the ends of the hull, which cause excessive strains.

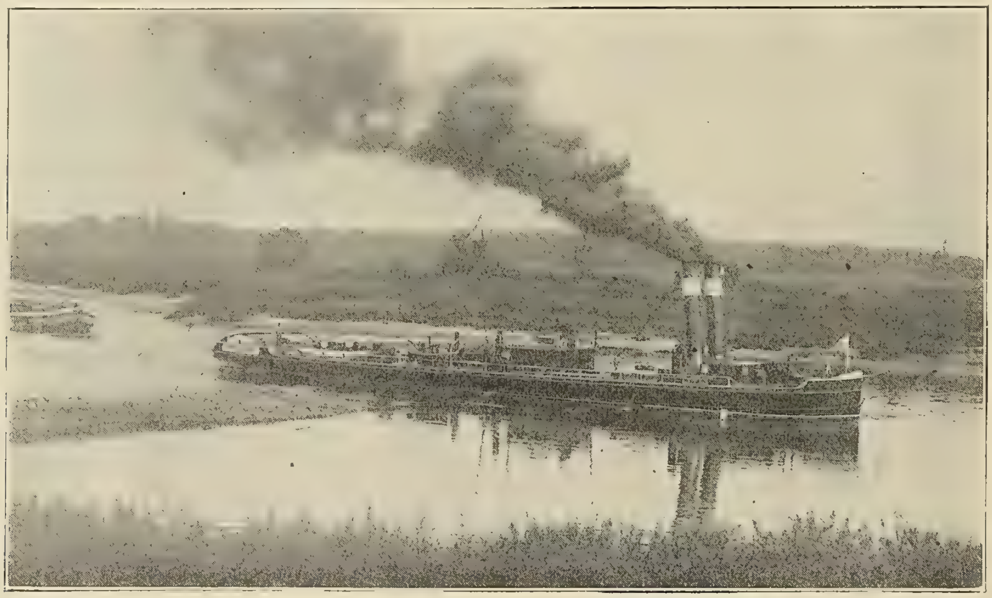


FIG. 2.

The outside plating consists at the bottom of plates ¼ inch, and on the sides of plates 3/16 inch in thickness. The seams are single-lap riveted, and the joints double-lap riveted. The deck consists of 3/16-inch corrugated sheets. At the bottom are fitted three intercostal keelsons, below the deck three fore-and-aft carlins, and on each side of the vessel one lateral stringer of similar construction. The stringers and keelsons are substantially connected with the web frames and six transverse bulkheads. Furthermore, the central keelson is connected as efficiently as possible with the central fore-and-aft carlin of the deck, by diagonal bars and longitudinal bulkheads. Deck stanchions, consisting of gas-pipes and angle or T-irons, are also distributed conveniently throughout the ship.

The after third of the ship's length is occupied by the engine room. At the after extremity, the shape of the vessel is drawn in so as to leave room on each side for a paddle wheel of about 8 feet width. Midships are fitted the cabins, comprising quarters for two machinists, a room for the pilot, and a kitchen for the machinists. A special staircase leads down to the captain's and owner's room. In a deckhouse, situated above, are installed the steam-operated steering engine, the men's kitchen and mess, two lavatories and a lamp chamber.

Above the deckhouse is installed the flying bridge, with the hand-steering apparatus. In front of the cabins there is a small hold, 10 feet in length, and in front of this the coal bunker, 16½ feet in length, designed for storing about 55 tons of coal. In front of the bunker is situated the boiler room, which, in order to allow for sufficient height for the boilers and steam accumulators, is covered over with an iron hood. In front of the boiler room are found the two staterooms set apart for the three boatswains and three stokers. The peak of the ship is designed as a watertight trimming tank, being provided with the necessary piping for this purpose. This tank is designed for storing up to 10 tons of water, with a view to compensating any alteration in the draft of the ship, as produced by the consumption of coal.

On the fore-deck is installed a steam-operated windlass, with spindle brake, two chain discs and two windlass heads. This is also designed for hand operation. On the after-deck is installed a hand-operated capstan.

The towing attachments comprise a well-moored rope clamp and spindle, a double towing bollard and a winch for drawing in the towing rope mounted behind the flying bridge. From the rope clamp the rope is taken over an iron-pipe towing pillar, which can be shifted by means of chains and rollers and a winch. The head of this towing pillar is provided with a roller guide. Above the after part of the ship are installed four gas-pipe towing bitts for guiding the towing rope, parts of which are readily removable.

The engine is an inclined triple-expansion three-crank engine, the intermediate and low-pressure cylinders being arranged beside one another, and the high-pressure cylinder in the center and in front of the same. The cylinders are 16½, 24 13/16 and 41 inches in diameter, respectively, with a stroke of 55⅛ inches. The output, with a charge of about 60 percent in the high-pressure cylinder, is about 600 indicated horsepower. The high-pressure and intermediate-pressure cylinders are provided with steam jackets, which, however, can be cut out. The valve gear is of the Joy type, a steam engine being used for reversing, according to the "all-round" system. The air pumps, bilge pumps and feed pumps are mounted on the front extension of the piston rods of the middle and low-pressure cylinders.

The two 7/16-inch sheet steel paddle-wheels are about 13 feet in diameter, and are fitted with seven paddles, each 8 feet by 3 feet. The hubs and eccentric rings for operating the paddles are of cast steel. The rods are of soft wrought iron of high strength and malleability, the bolts of steel and the bolt bushes of hard phosphor bronze.

The condenser is of the jet type, a pre-heater (which can be cut out) serving to heat the feed water. The steam is generated by two return-tube cylindrical boilers, placed beside one another, with a total heating surface of about 2,000 square feet, operating at a pressure of about 200 pounds per square inch. The steam is led into a common steam accumulator.

The main steam piping between the boilers and engine, as well as the auxiliary steam and feed pipes, are patent welded iron pipes with welded-on flange rings. These pipes are located in a special iron tube channel below the deck, which is provided with the necessary admission openings.

A steam donkey pump is used for boiler feeding and deck washing, as well as for a bilge and fire pump. There is also a boiler feed injector, a pressure pump and a small hand pump for filling the boiler, as well as a bilge pump ejector.

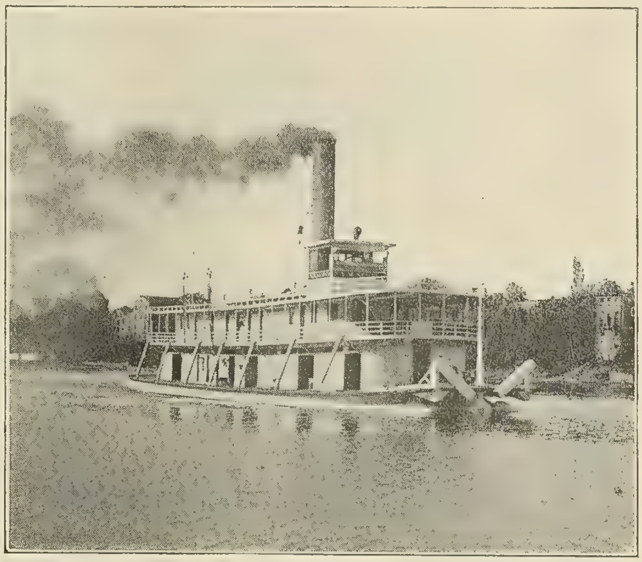
The Bureau of Navigation reports that 125 sail and steam vessels of 42,745 gross tons were built in the United States and officially numbered during the month of September, 1910. Five steel steamers, aggregating 23,754 gross tons, were built on the Atlantic coast.

TWIN SCREW TUNNEL STEAMERS VS. STERN-WHEELERS FOR SERVICE ON THE WESTERN RIVERS.

BY CHARLES E. WARD.

The conditions governing the navigation of the Western rivers of the United States are peculiar, demanding a steamer of good carrying capacity on a limited draft, with the ability to make quick landings at any point along the river. As only the larger towns and cities have wharf boats many landings must be made head-on the bank.

These requirements have developed a type of steamer having handling qualities that until recently have never been equaled. The limited draft necessitates a flat bottom and full, flaring bow, the model being under instead of around. As the stern-wheel is the accepted method of propulsion, and the engines are placed aft, a full stern must be provided to carry



TWIN-SCREW TUNNEL STEAMER A. M. SCOTT.

the excessive weights. This is counterbalanced to a great extent by locating the boilers well forward. Longitudinal stiffness is obtained by a system of hog chains and braces.

Large balanced rudders, from two to four in number, are hung from the transom, forward of the wheel, and are, of course, most efficient when the boat is backing. It is this feature that gives the quick-handling qualities, and enables them to back away from a landing and straighten up on their course with the least possible delay.

The Western river tow usually consists of from sixteen to twenty-four barges, 26 feet by 135 feet, loaded to 6 feet draft, all securely chained together, and the towboat is rigidly fastened to the stern of the tow and pushes them ahead.

The problem of steering these large tows, especially when loaded, going down stream, demands serious consideration; it is this condition that the stern-wheel towboat has met, but at a cost which few, if any, realize. For instance, when approaching a bend in the river the rudders are put hard down to port or starboard, the engines then working astern at from half to full power, the current from the paddle-wheel acting on the rudders throws the stern of the boat and tow in the desired direction, the current then swings the body of the tow into the channel; the engines are started ahead until it is necessary to change the course, when the headway is again checked in order to accomplish results that should be obtained without appreciable loss of headway and power. Fully one-eighth of the time is spent in backing and flanking the tow

around bends and through chutes, a most extravagant waste of power and fuel, as the engines invariably work at full stroke (no cut-off) when backing.

The engines are generally high-pressure, non-condensing, located aft on each side, with long connecting rods to the cranks, which are at right angles on each end of the shaft. With 200 pounds steam pressure, cut-off at from one-half to three-fourths of the stroke, economy is out of the question. Some of the recently-built steamers, especially the larger towboats, have tandem compound-condensing engines, which are, of course, more economical, though still far behind the results obtained with the use of triple-expansion condensing engines.

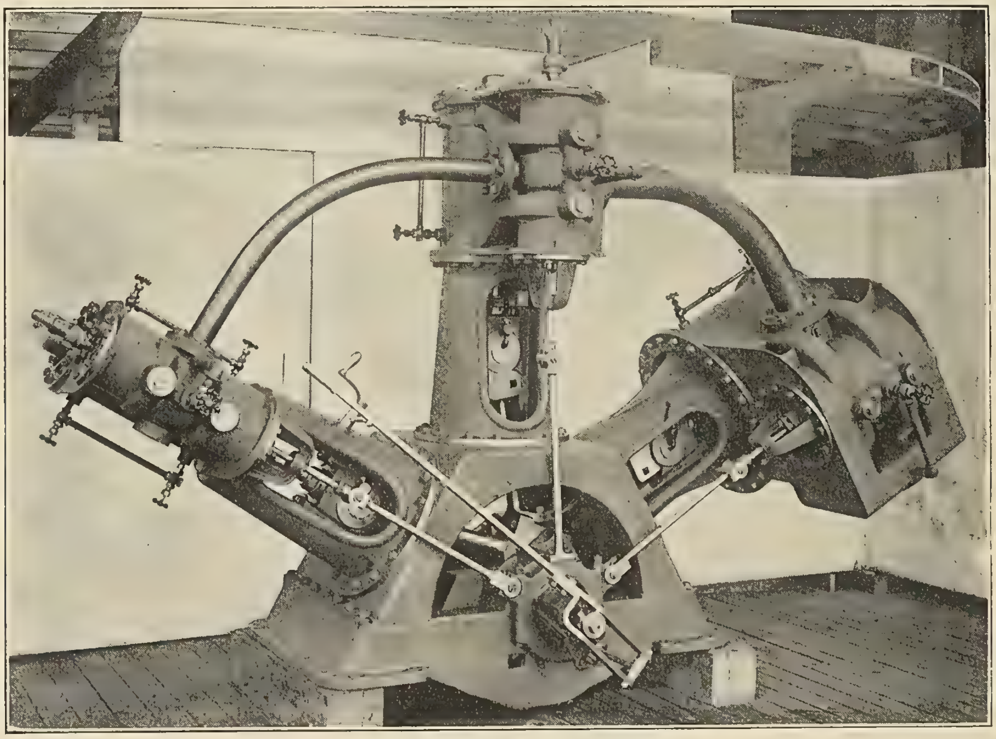
River men resent any effort to supplant their useful, though extravagant, stern-wheelers, even though the change means a saving of nearly half the fuel bill, a sum that would buy a new boat in less than six years' running time.

Tunnel boats have been in use for a number of years abroad, many of them for service on the Nile, built by Yarrow & Company and Sir John I. Thornycroft. These boats have given excellent results in speed and economy, but they do not possess the necessary handling qualities for service on the rivers of the United States.

Realizing the necessity for improvements in shallow draft river steamers, the writer has devoted considerable time and study to the development of the tunnel boat for towing and passenger service, embodying the desirable features of the stern-wheel boats now doing such excellent work, and obtaining economy in fuel and operating expenses that demands serious consideration. In the last few years the Charles Ward Engineering Works has designed and built six tunnel boats, all of them being in successful operation at various points on the Western rivers. The latest addition to the fleet is the steamer *A. M. Scott,* a twin-screw tunnel towboat, 150 feet long; 26 feet beam molded; 28 feet beam over the guards; depth, molded, 5 feet; sheer forward, 2 feet; sheer aft, 1 foot 6 inches; draft, with 70 tons of coal in bunkers, 3 feet.

The under body and tunnels are of special design to give easy run to the propellers and room for the four rudders, which are located in the tunnels forward and aft of the propellers, thus utilizing the full force of the stream of water from the wheels, either ahead or astern. This is a decided improvement over any other type of tunnel steamer, and possesses all the advantages of the stern-wheel towboat when backing or flanking, and gives the greatest possible rudder power when going ahead, due to the action of the wheel water on the after rudders. The rudders are so powerful that the boat can steer her tow through many places that a sternwheel boat would have to stop and flank into position. Maneuvering trials have shown that this boat, when backing and swinging hard to starboard or port, will change and swing in the opposite direction by simply reversing the rudders without stopping the engines.

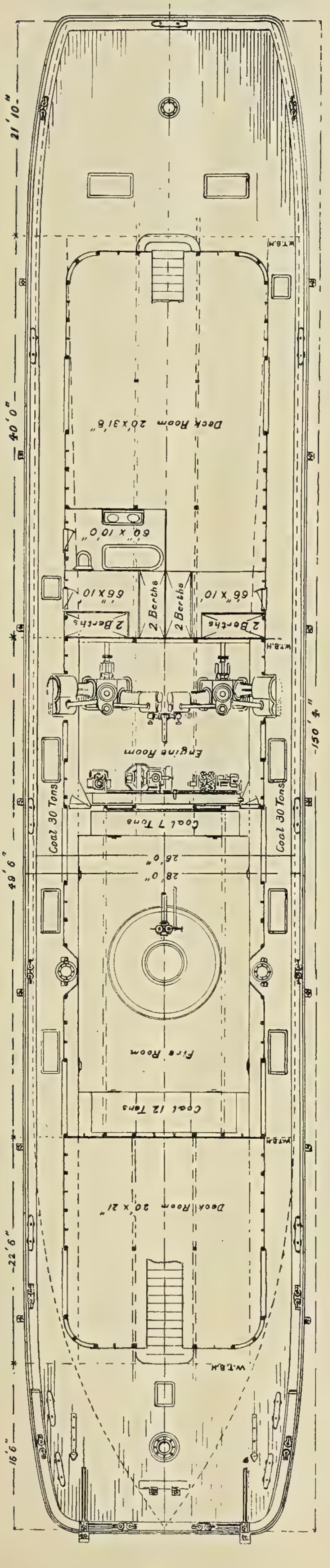
The propellers are 5 feet in diameter, spaced 11 feet 6 inches from center to center, thus giving a twisting power by backing on one engine and going ahead on the other, which will lift the boat's head to port or starboard, a most desirable feature if hemmed in—bow and stern—by barges.



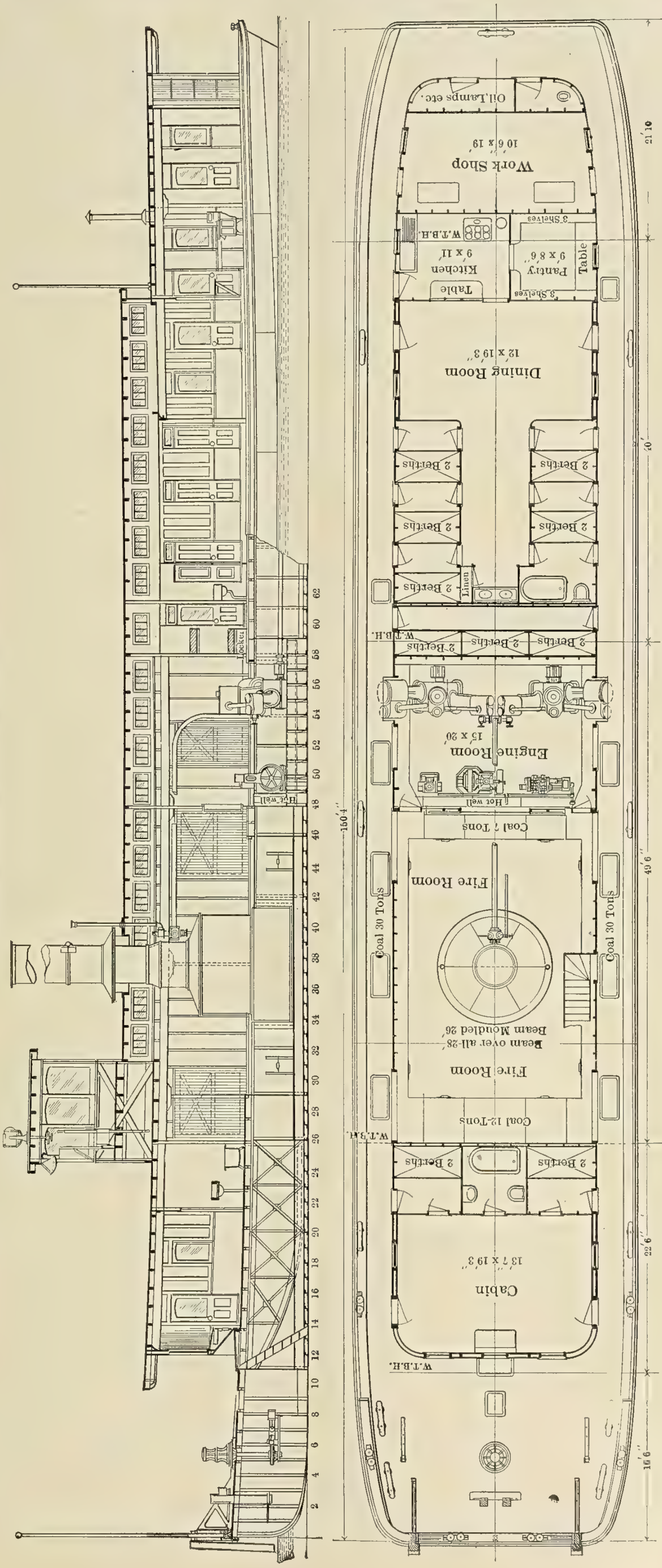
SINGLE-CRANK TRIPLE WARD ENGINE.

The engines are triple-expansion condensing, having cylinders 9 inches, 14½ inches and 25⅝ inches diameter by 14 inches stroke, of special design to secure the highest economy and simplicity. As shown in Fig. 2 the piston valves are operated by a single eccentric and three eccentric rods; the reversing and cut-off being obtained by sliding the eccentric across the shaft. A single-throw crank shaft eliminates four main bearings and their up-keep. The simple valve gear dispenses with five eccentrics, their straps, three pairs of links, reverse shaft, bearings and levers—a direct saving in moving parts, resulting in much more efficient operation and reduction in maintenance. An oil pump, driven by the low-pressure eccentric rod, furnishes ample lubrication under pressure, the oil returning to the crank case and being used again.

A Ward watertube boiler, having 3,000 square feet of heating surface and 100 square feet of grate, furnishes steam at 275 pounds pressure, with natural draft, on a coal consumption of about 1,500 pounds per hour.



DECK PLAN TUNNEL STEAMER A. M. SCOTT.



INBOARD PROFILE AND DECK PLAN OF MODERN TWIN-SCREW, SINGLE-DECK TUNNEL STEAMER.

The condensers are of the outboard sectional type, with provision for reducing the cooling surface in the winter.

The exhaust steam from the auxiliaries is passed through a feed-water heater and from there direct to the hot well, making a most efficient feed-water heating system.

The boiler and engines are located mid-ship, as shown on deck plan (Fig. 3), and occupy less than 50 feet length of boat. Coal bunkers of ample capacity are arranged all around the boiler, thus avoiding the usual fuel boat and coal passers.

The hull is of the best open-hearth steel plate, built on a substantial framing of steel angles, Z-bars and channels. Two longitudinal bulkheads provide ample stiffening, no hog chains or braces being necessary.

The cabin and deck house conform with the usual practice of the Western river steamers. If desired for navigation in rivers obstructed by low bridges the necessary accommodations can be had on the main deck, as in the modern twin-screw river towboat (Fig. 4).

The steamer *A. M. Scott* develops 700 horsepower and possesses many advantages over the regular stern-wheel steamer, the greatest being the reduced coal consumption, due to the economical type of machinery, obtaining the greatest power on the least displacement, resulting in a direct saving in power required to propel the boat alone of nearly 50 percent, as a stern-wheeler of the same power will have about double the displacement. Due to the special form of the stern and location of the rudders, the *Scott* is a decided improvement, and has demonstrated the fact that a tunnel boat can be built with all the handling features of a stern-wheeler and possessing many qualities peculiar to the tunnel boat that cannot be had with any other type.

The steamer *Robert P. Gillham*, owned by the Campbell's Creek Coal Company, represents the most recent practice for stern-wheel towboats, and as she has slightly more power than the tunnel steamer *A. M. Scott*, a brief description and comparison of the two boats will be of interest.

The *Gillham* has a wood hull 150 feet long, 172 feet over all, 31.8 feet beam, 4 feet 6 inches deep, and has a draft of 4 feet 3 inches, when fully coaled, on a displacement of over 500 tons. The main engines are double-tandem compound condensing, 14 inches and 24 inches diameter, with a stroke of 7 feet, coupled at each end of the shaft to cranks at right angles, turning a paddle-wheel 19 feet in diameter, 22 feet face, having fifteen buckets 30 inches wide. The steam and exhaust valves are of the balanced poppet type, operated by the McConnel inside cam valve gear, giving variable cut-off from about three-eighths to full stroke. A duplex plunger pump, with plungers 4½ inches diameter by 10 inches stroke, is used for feeding the boilers. The circulating water, after leaving the condenser, is piped about 80 feet forward to the ash-pan, which is constantly flooded, the ashes being washed overboard through an ash chute.

There are four horizontal cylindrical boilers, each 38 inches diameter and 28 feet long, with two flues 14 inches diameter in each, giving 1,750 square feet heating surface. They are set in battery with the usual firebrick and sheet iron casing. The furnace is 16 feet wide with grates 4 feet long. Two mud-drums are placed athwartship, one just aft of the furnace and the other near the end of the boilers, and a steam drum extends across the top of the boilers, which are connected to the mud and steam drums by large water and steam legs. As the engines are condensing, the exhaust cannot be used for forced draft, which is obtained by eight steam jets, one at the end of each flue. The draft is sufficient to burn from 40 to 45 pounds of coal per square foot of grate per hour.

Indicator cards from the *Gillham's* engines, while making a trip up the Ohio River with a tow of twenty-four empty barges, each 26 feet by 135 feet by 18 inches draft, and two fuel boats, give a total of 770 horsepower at twenty revolutions and 200 pounds steam, with a coal consumption of about 800 bushels in twenty-four hours, or 2,660 pounds per hour, or 3.4 pounds per horsepower. The coal is carried in a small barge or fuel flat, and passed in wheelbarrows to the fire-room, each barrow holding approximately 2½ bushels, requiring about 336 barrows each twenty-four hours, which is somewhat in excess of the 800 bushels given.

The main deck is devoted almost entirely to machinery, boilers and coal, thus occupying about seven-eighths of the length of the vessel, a condition that would not be tolerated in any other service.

The following table gives the principal dimensions and salient features of the two types of steamers, and shows at a glance the enormous saving by the adoption of tunnel boats using watertube boilers and the most economical engines:

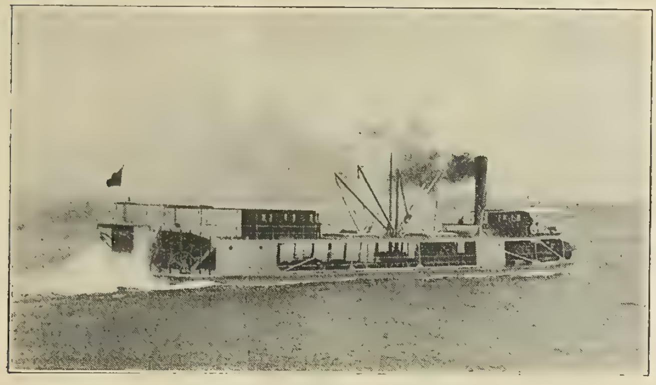
	Stern Wheel Steamer R. P. Gillham.	Twin Screw Tunnel Steamer A. M. Scott.	Saving in Favor of the Tunnel Steamer.
Length over all	172′	151′	21′
Length between perpendiculars	150′	150′	....
Beam	31′ 8″	26′	5.8′
Beam over guards	....	28′	....
Depth	4′ 6″	5′	....
Draft fully coaled	4′ 3″	3′	1′ 3″
Displacement, tons	500	225	275
Speed, miles per hour	12	15	3
Engines	(2) 14″ 28″ / 84″	(2) 9″ 14½″ 25⅝″ / 14″	....
Indicated horsepower	770	700	....
Steam pressure, pounds	200	275	....
Boilers	4—Cylindrical 38″ x 28′	1—Water Tube	....
Heating surface, square feet	1,750	3,000	....
Grate surface, square feet	64	100	....
Space required for engines, boilers and coal, square feet	3,740	1,000	2,740
Coal consumption per hour, pounds	2,660	1,500	1,160
Coal per square foot grate	41.5	15	....
Coal per horsepower per hour	3.4	2.14	37%
Cost of fuel per year, 300 days, $2 (£.41) per ton	$17,152 (£3,520)	$10,800 (£2,220)	$6,352 (£1,300)
Cost of labor to handle 3,176 tons of coal (3 or 4 times) not required for tunnel boat	....	....	$1,270 (£260)
Number of bearings to adjust including valve gear	112	22	90
Number of stuffing boxes	28	12	16
Flange joints on engines	68	34	34
Number of barges including steamer that can pass through locks	2	3	1

STERN WHEEL STEAMER AXHOLME.

The sternwheel steamer *Axholme*, built for Messrs. John Holt & Company (Liverpool), Ltd., by Messrs. Cammell Laird & Company, Ltd., at their Tranmere Shipyard, Birkenhead, was delivered in the River Mersey, boarded up for the voyage to the Niger. Previous to this the *Axholme* went through her trials in the Mersey in boisterous weather and proved herself efficient both in speed and steering capabilities.

The dimensions are 141 feet by 25 feet by 5 feet 6 inches. She has a main and upper deck; the upper deck stringer and curlin is made extra strong and supported and tied by T-bars to form a good girder.

The accommodation for crew is arranged under a monkey forecastle. Cabins for the pilot and engineer are aft, in steel houses. There are also galleys for both Europeans and natives, a bath room, toilets and stores in steel houses on the main deck. On the upper deck aft is a capacious cabin for agents and others, built of teak. Forward is a cabin of teak for the captain. Both of these cabins are nicely fitted up and upholstered. A shade deck is fitted over these deckhouses, and kept well over the roof of the cabins, to ensure a current of air passing over them to keep cabins as cool as possible. Can-



A LIGHT BRITISH-BUILT RIVER BOAT.

vas curtains are fitted all around vessel, both for the main and upper deck, to give protection from heat and rain.

Especial attention has been paid to ventilation on the lines of Prof. Ross's recommendation for the prevention of African fever, and measures have been adopted by which the crew of the vessel, both European and native, are protected from the bites of mosquitoes and other tropical insects.

The machinery, also built by Messrs. Cammell Laird & Company, Ltd., consists of compound surface condensing engines having cylinders 15 inches by 30 inches by 42 inches stroke. The boiler is of the locomotive type, having ample heating and grate area. The builders guaranteed a light draft, deadweight on 4 feet, and speed loaded, all of which were successfully attained with ease. The vessel and engines were built under the supervision of Messrs. A. C. Hay & Smart, consulting engineers for the owners.

This boat is the first of her class built for the transport service of the River Niger, and is specially intended for handling cargo of all kinds with despatch, being fitted with powerful winches for this purpose, as well as for hauling the vessel off banks whenever she gets aground. By those well acquainted with the river, this boat is considered one of the most efficient and up-to-date vessels built for the trade. She was towed from Liverpool to the Niger by one of Messrs. John Holt & Company's ocean steamers, the *Balmore*.

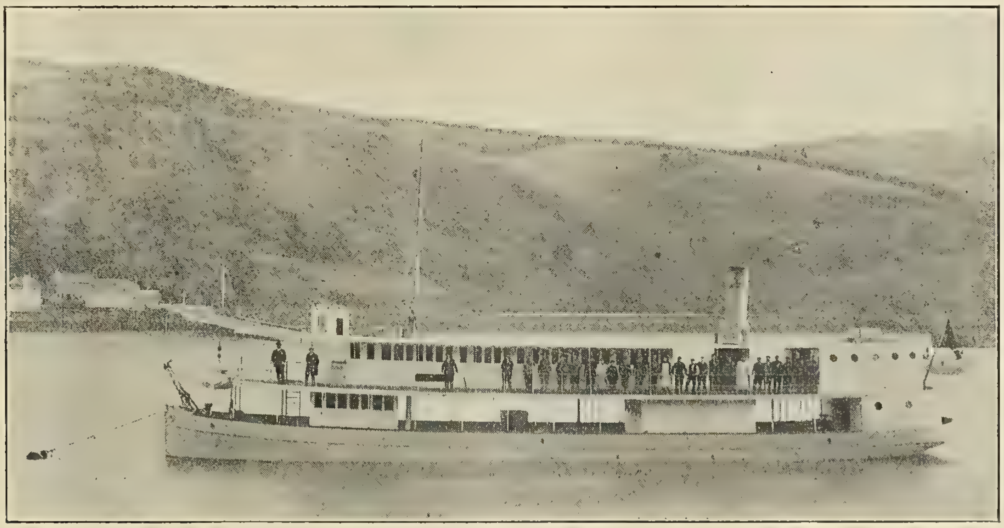
The new 45,000-ton White Star Liner *Olympic* was launched successfully at the Harland & Wolff Shipyard, Belfast, October 20.

Twin Screw Shallow Draft Steamer Diego Martinez.

The *Diego Martinez* is a twin screw shallow draft steamer, built by Messrs. Philip & Son, Ltd., of Dartmouth, for passenger and cargo service at Cartagena, South America. The principal dimensions are: Length over all, 115 feet; length between perpendiculars, 110 feet; beam, molded, 20 feet; depth, molded, 7 feet; draft with passengers, stores coal, water and 150 tons of cargo on board, 5 feet. Under full load conditions, in fair weather the vessel averages 9 knots. The machinery consists of two sets of compound surface condensing engines and two return tube marine boilers, the working pressure of which is 130 pounds per square inch. There is one condenser common to the two main engines and the air and circulating pumps are of the independent duplex double-acting horizontal type.

The hull throughout is built entirely of steel with a steel main deck and teak upper deck. The passenger accommodation is made suitable for hot climates, the first class passengers being housed on the upper deck and the third class passengers on the main deck.

The vessel steamed from the builders' works to Cartagena without mishap, coal and stores sufficient for the voyage being carried in the hold.



THE DIEGO MARTINEZ, BUILT IN ENGLAND FOR SOUTH AMERICAN SERVICE.

THE MACKENZIE RIVER.

Going back over records of stern-wheel steamboats, which have been designed and built in accordance with plans and specifications furnished by Marine Iron Works, Chicago, there is none that seems to be of greater interest than one completed about two years ago, now in operation in the far northwestern part of the North American Continent. The hardships and difficulties met in transporting machinery, as well as parts of boats in this country, are of a character that would cause a great many to hesitate in going ahead with the project of building a boat for this service.

The craft that we have in mind is the *Mackenzie River*, owned by the Hudson's Bay Company, which was constructed at Smith's Landing, situated at the head of the great chain of lakes and river navigation, extending northward without obstruction for a distance of 1,800 miles through comparatively wild and barren territory, emptying into the Arctic Ocean. This far northern region is sometimes designated as the "Land of the Midnight Sun," on account of the fact that, during the summer months, commencing with June, there is continuous sunlight, and during the longest day the sun does

not go below the horizon. This gives one a faint conception of the long distance that a boat the size of the *Mackenzie River* had to travel before it finally reached the point where it was to be built, and the difficulties encountered in transporting it from the Great Lakes region of the United States to its destination, where it was erected and the machinery installed and placed in operation.

The steamer *Mackenzie River* is of the stern paddle-wheel type, and of the following dimensions:

Length on deck	125 feet
Beam outside of planking	26 feet
Depth, forward	7 feet 10 inches
Depth, minimum	5 feet 4 inches
Dead rise	8 inches
Flare in sides	3 inches
Block coefficient up to 32-inch waterline	57.3 percent
Draft, steam up ready for load	32 inches
Draft, 100 tons cargo aboard	4 feet

The stem is a 10-inch by 20-pound channel. The frames, spaced 12 inches, 16 inches and 18 inches heel to heel, are formed of 3-inch by 2-inch by 5/16-inch angles, every frame having a 3-inch by 2-inch by ¼-inch continuous reverse frame carried up past the turn of the bilge. The deck beams are 2½ inches by 2 inches by ¼ inch riveted to the top cords of the trusses and to the side frames, with 5/16-inch bracket plates. These deck beams are laid bosom up and are filled with 2½-inch by 5½-inch wood deck beams. There are two side trusses and one center and two wing trusses, built under the center and side hog chain systems. Each truss is formed as follows:

The top cords are composed of two 4-inch by 3-inch by 5/16-inch angles, back to back, riveted to the deck beams. The bottom cords are composed of two 4-inch by 3-inch by 5/16-inch angles, back to back, riveted to the reverse floor frames.

The struts, of lattice construction, are formed of 2½-inch by 2½-inch by ¼-inch angles, fastened to the top and bottom cords, and are fastened together where they cross by 5/16-inch thick plate brackets.

The deck stringers are continuous fore and aft from stem to stern. They are of 33-inch by ¼-inch plate, with the inside edge riveted to the outside cord of the wing truss.

There are two fender angles on each side, 3 inches by 2 inches by 5/16 inch, continuous from stem to stern.

The keel and bilge plank is 2¾ inches, the bottom and side planking 2½ inches. The strength and safety of the hull are increased by five watertight compartments.

On the main deck is a commodious house containing cargo space in addition to the machinery and crew's quarters at the after end, also a kitchen, pantry, toilet room, etc. Above this, on the upper deck, is a commodious house containing a dozen staterooms for passengers, a large dining room, handsome smoking room at the forward end and ladies' cabin aft. Above the second deck is located the master's room and pilot house, which is designed for convenience and comfort.

The hull of the vessel is of light construction, special steel being used to enable her to navigate safely the waters of the Mackenzie River. Longitudinal strength has been adequately provided in the form of five lattice girders and numerous hog post ties. Bulkheads provide for ample transverse strength. The bow has been made especially strong to resist the impact of ice, snags, etc. Frequently, even in mid-summer, while crossing the Great Slave Lake, immense fields of ice are seen or encountered.

At 4-foot draft of water the steamer will carry 60 tons of deadweight cargo, in addition to 30 tons of fuel.

The machinery consists of a pair of Marine Iron Works, direct-acting modern stern paddle-wheel marine engines, capable of being worked up to and over 250 horsepower. Each engine cylinder is 12 inches diameter by 60 inches stroke, and is fitted with a piston valve for the high working pressure which it is consistent to carry on machinery of this character.

The boiler is a horizontal locomotive fire-box, direct-draft marine type having a large deep fire-box for burning wood, and, being built under the Canadian marine rules and regulations, licensed to carry 180 pounds steam pressure.

The boat is also fitted with a special design of steam capstan of the double-drum type, operated by a pair of double-acting 5-inch by 7-inch engines.

The paddle wheel is 16 feet diameter by 16 feet long, strongly built, well ironed, and under normal conditions will make about 27 revolutions per minute.

Everything connected with the work was made to comply

FIG. 1.—TRANSPORTING THE BOILER ACROSS THE PLAINS.

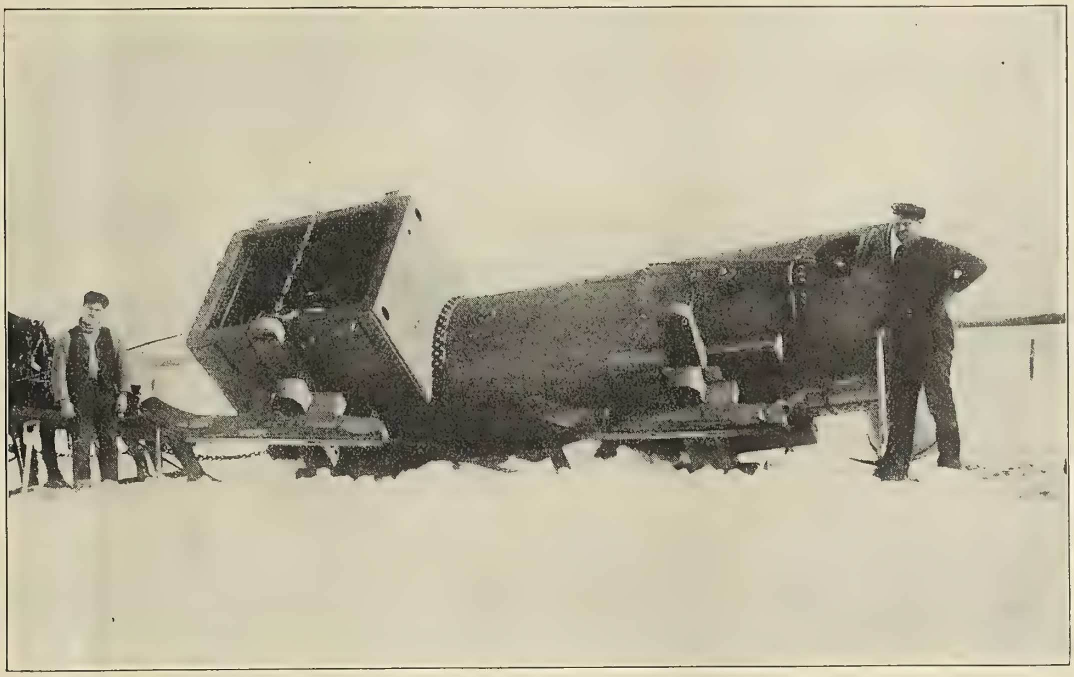


FIG. 2.—UPSETTING OF LOAD; ONE OF THE DIFFICULTIES IN DELIVERING TO RIVER LANDING.

with the Canadian marine rules and regulations and to the satisfaction of the Hudson's Bay Company's representative.

The hull of the *Mackenzie River* is composite construction —steel framework, wood planking. All of the steel framework was fabricated at the plant of Marine Iron Works, loaded with the machinery on cars and delivered by railroad to the town of Edmonton. From Edmonton to Fort Smith the real hardships and difficulties of the job began, as from this point all of the work, as furnished by Marine Iron Works, was transported to Athabasca Landing on sleds through deep snow. Some of the illustrations give a fair conception of what was encountered.

Fig. 1 shows these sleds loaded with the boiler and other parts of machinery a short ways from where it was unloaded from the car. The material was conveyed in this manner over what is known as the plains, beyond which the mountains and timber region are located.

Fig. 2, of the sled partially upset with the boiler, and in a country where the snow is several feet deep, illustrates the difficulties that were encountered and which, without the aid of lifting jacks, etc., for readjusting the loads, would be discouraging to the average man.

The distance which this machinery with the boat frames was hauled, from Edmonton to Athabasca Landing, is approximately 100 miles. At Athabasca Landing, the gentleman who had charge of the transporting and re-erecting of

FIG. 3.—BARGE WITH BOILER, JUST AFTER BEING WRECKED ON THE ROCK AT ONE OF THE RAPIDS.

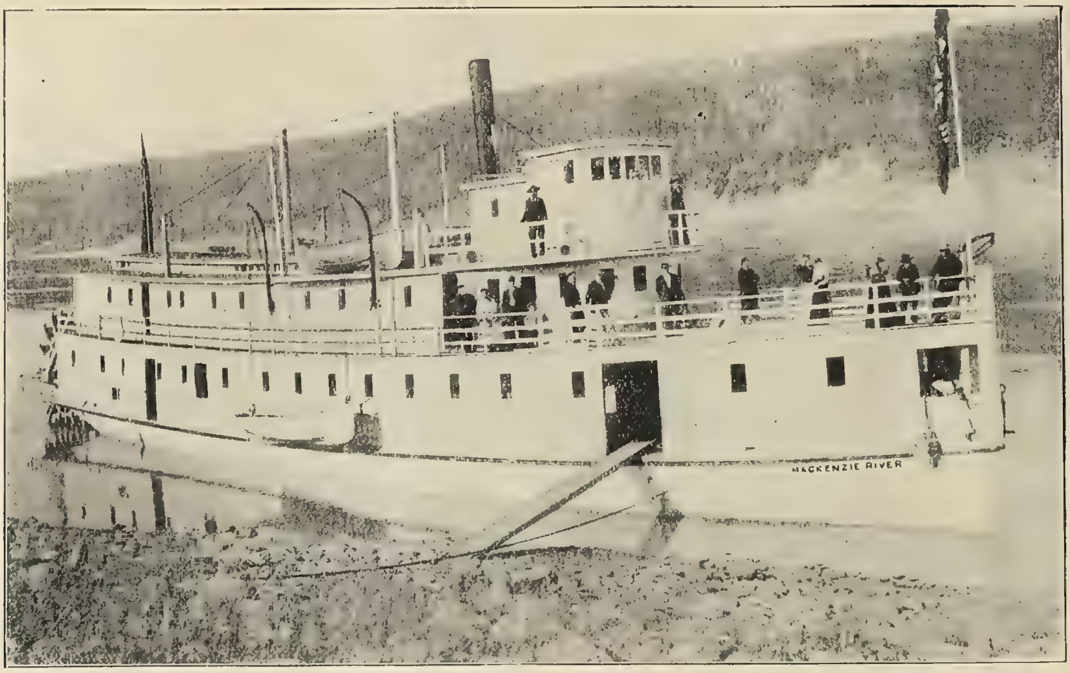


FIG. 4.—THE COMPLETED BOAT WITH THE BOILER AND MACHINERY IN PLACE READY FOR HER INITIAL TRIP.

the boat (Capt. Mills) began the first operation towards preparing the boat and machinery for its initial trip on the water, for here were constructed scows, or barges, on which were loaded the machinery and frames, and they were transported on these barges a distance of 252 miles through the dangerous rapids of the Athabasca River. During this part of the journey one of the scows carrying the boiler struck on the rocks, and Fig. 3 shows this mishap shortly after it had taken place. Driftwood and other material piled up around the boiler inside of twenty-four hours after the mishap, but by the use of lines, pulleys, etc., the boiler was hauled to shore, a new scow constructed, into which the boiler was loaded and delivered at Fort Smith. The principal help that assisted in getting the boiler ashore and loading it onto the new scow or barge consisted of native Indians.

In transporting this material four portages were en-

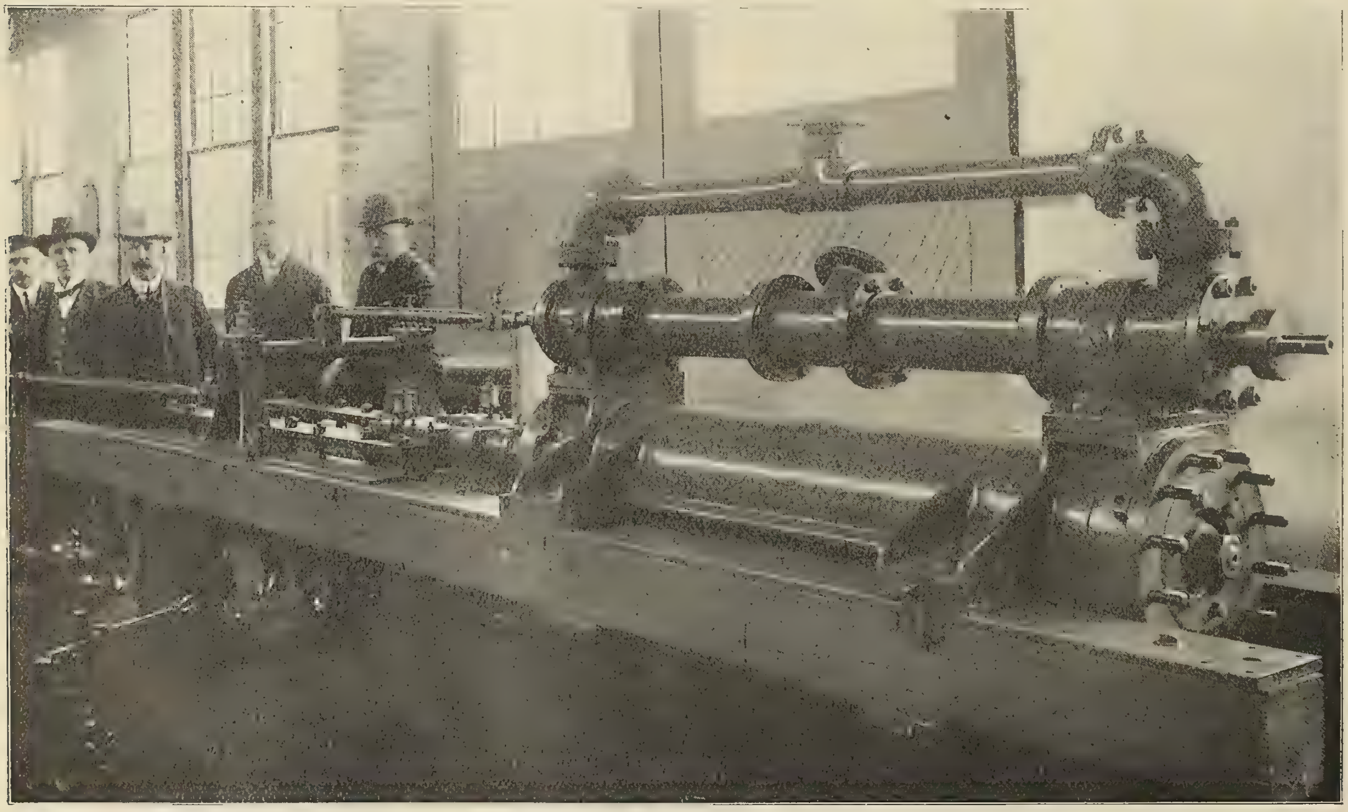


FIG. 5.—ENGINES OF STEAMER MACKENZIE RIVER.

countered, that is, four times during the journey the material was unloaded from the scows, transferred across and around rapids, the scows being transported overland, launched, and the machinery again loaded.

Fig. 4 shows the completed boat shortly after she was put into service for a run on the Mackenzie River and Great Slave Lake, where she has been and is now in very successful operation, proving a credit to the owners as well as the designers and builders.

Taking into consideration the hardships that Capt. Mills met with in transporting the steamer, it seems almost a miracle that the actual loss of supplies that accompanied the boat from its original building amounted to only a few kegs of rivets, and which the captain—being a man of resource—replaced by cutting some bars of round iron (which also went with the shipment) into the desired lengths for these rivets.

Fig. 5 shows the engines of the *Mackenzie River* while they were being erected at the shops of the builders, and just previous to the steam test.

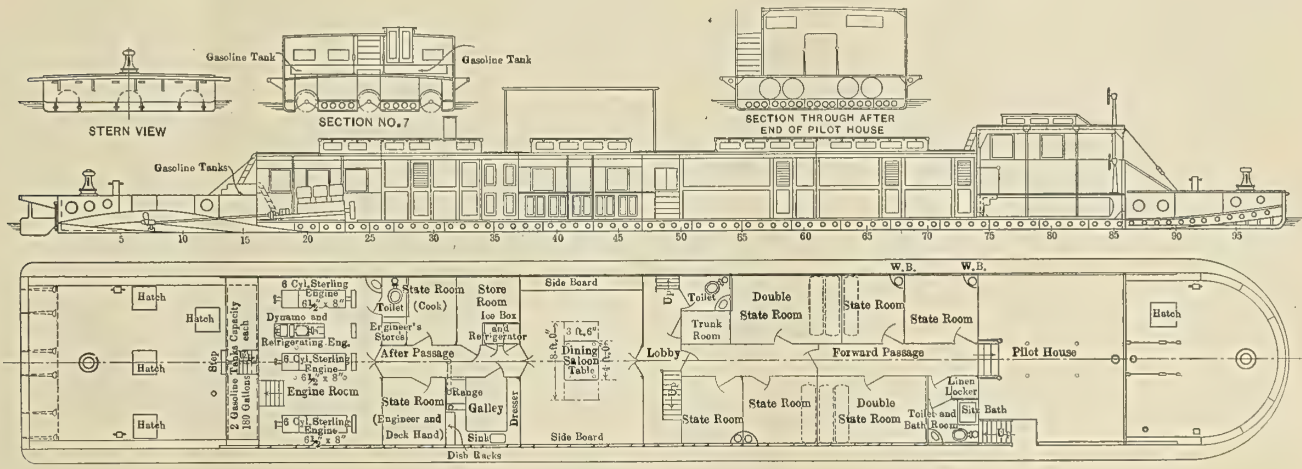
In the preliminary erection of the framework of the boat by the builders the greatest care was used in the manner in which every piece was marked, so that no one, however inexperienced he might be in shipbuilding, could have any difficulty in re-erecting the work with the aid of the clear and complete drawings showing the corresponding numbers that accompanied this boat.

and has commissioned Gielow & Orr, of New York City, to work out the various details of this craft; this firm also is superintending the construction of the vessel. The contracts have been signed, and she is now being built at the Howard Ship Yards Company, Jeffersonville, Ind., and will be ready for her owner's use on or before the 1st of February, 1911.

The principal dimensions of this new craft are: Length over all, 130 feet; length on load waterline, 126 feet, and beam, extreme, 20 feet 8 inches. The most remarkable feature is her extremely light draft, which will be only 12½ inches when fully loaded and with all her equipment on board.

The hull of the boat will be constructed of mild steel of the very best quality, and her scantlings, while light, are in no sense extremely so. In fact, her plating ranges from 3/16 inch to ¼ inch in thickness. The hull is sub-divided into a number of compartments by means of steel bulkheads, so that, even with several compartments filled with water, the vessel will still remain afloat.

Great structural strength is obtained by a system of cellular construction of her bottom, which makes the vessel exceedingly rigid and able to withstand the various buckling and twisting stresses to which she may be subjected in case of grounding. Although not intended for outside or sea work, great longitudinal strength is obtained by carrying up the framing of the hull to the upper deck, and by means of steel deck beams, stringers, plates and diagonal bracing.



DETAILS OF A TRIPLE-SCREW, SHALLOW-DRAFT TUNNEL YACHT.

A SHALLOW DRAFT YACHT.

The many bayous and connecting waters of the lower Mississippi River and many of its smaller and shoaler tributaries are a new and almost unknown field in the yachting world, and the conditions surrounding the navigation of these waters require a craft differing very materially from the conventional yacht found in Northern and Eastern waters.

Some of the rivers of the West and Southwest have been known to shift their channel several hundred yards in one night, so that a boat comfortably anchored at night may find itself high and dry and several hundred feet from the water's edge before morning, requiring skids and rollers to bring her back to her native element.

These conditions, logically, demand a vessel of exceedingly light draft, combined with great structural strength, so as to be able to navigate in very shoal water, as well as to be able to withstand the heavy stresses when running aground or being left aground by a rapidly falling stream.

A Western yachtsman, who has had some experience in these comparatively unknown waters, has decided to have built for him a vessel especially adapted to meet these requirements,

The decks are constructed of five-ply white wood veneer, ⅝ inch in thickness, each in five layers, three running fore and aft and two athwartships, glued together with a special glue capable of withstanding moisture indefinitely. These decks are painted on both sides, and are covered with canvas, which is also painted. The stateroom bulkheads are all constructed of similar material, and all the doors of lightest possible design, with "Louvre" panels in their upper halves.

The bow is of the spoon type, semi-circular at the deck line; and along each side, extending all around the vessel, is a guard and walking platform of perforated steel plating, all properly sponsoned and braced, 18 inches in width.

The pilot-house commences 17 feet aft from the forward end of the vessel, and is 15 feet in length fore and aft, extending the full width of the vessel. This will be used as a social hall and smoking room, and there will be a steering gear, arranged to operate from the inside of the pilot-house, as well as from the bridge above.

For a distance of 30 feet aft of the pilot-house the space will be occupied by two double and four single staterooms and two bath and toilet rooms. Aft of this will be a lobby or athwartship passage, 4 feet fore and aft, with a gangway outboard,

and a stairway leading to the deck above. Aft of this will be a dining room, 12 feet 6 inches in length, extending full width of the vessel, fitted with dining table, buffets, sideboards, china closets, etc. Abaft of the dining room will be a galley on the starboard side and a store room, pantry and refrigerator on the port side. Aft of this, on the port side, will be a stateroom for the cook and steward, and on the starboard side a stateroom for the engineers. Next comes the engine room, 12 feet 6 inches in length, and abaft of this the after-deck, 31 feet long, stiffened and braced to be able to carry an automobile and other heavy loads.

In addition to the windows in the sides of the cabin skylights are provided, so as to insure the most perfect ventilation possible. The interior woodwork will be finished in white enamel throughout, excepting the bureaus and other furniture, which will be of hardwood, finished bright. Brass bedsteads will be used in all the staterooms; and the plumbing system provides for running water throughout the vessel.

The propelling machinery will consist of three 60-horsepower, heavy-duty Sterling engines, which will be capable of driving the vessel at a speed of at least 12 miles per hour. On account of the light draft required, the propellers driven by these engines will be operated in tunnels, so that the wheels will be fully protected from submerged logs, or in case of the vessel grounding. The gasoline will be carried in cylindrical steel tanks, especially enclosed in watertight compartments, and these tanks will have a capacity of 1,500 gallons, which will give a cruising radius of over 1,500 miles at normal speed.

The yacht will be equipped with an electric light plant and storage batteries, and will also have an independent ice machine and refrigerating plant, thus supplying ample cold storage for carrying perishable provisions on extended cruises. Power capstans are provided at each end for handling lines and for use in pulling the vessel off in case of grounding. The usual boats will be provided.

Throughout the yacht will be furnished and fitted in a tasteful and comfortable manner, and as she is so much of a departure from the conventional her performance will be watched with more than usual interest.

A PROPOSED DESIGN FOR A STERN-WHEEL RIVER STEAMER.

The illustration shows the design for a large Missouri River steamboat, as worked out by James Rees & Sons Company, Pittsburg, Pa., from the ideas of Captain John Todd, one of the oldest and best navigators and builders of steamboats on the Missouri River. The most important feature of this design, as shown at a glance, is the use of two independent wheels. The first twin stern-wheel steamboats were built in Pittsburg in 1852. During the next few years six were built with this arrangement of wheels. They were the *Challenge* in 1854, the *Aunt Lettie, North Star, William Baird, Alma* and *Adriatic* in 1855. The steamer *I. S. Pringle* also had four engines with two separate wheels astern. Since these boats were built, however, independent stern wheels have not been used on river boats. The design shown herewith of the steamer *John Todd* is, therefore, the first attempt to utilize this method of propulsion in a modern river boat. As shown in the drawings, the starboard wheel is operated by a cross compound and the port wheel by high-pressure engines with boilers in two independent batteries connecting to one main steam pipe under control in the center. The boat has four balanced rudders and steam steering apparatus

The designers are of the opinion that a boat of this kind is the very best type for the quick transportation of freight on the western rivers of America. It is expected that she would be able to navigate any part of the river where a very much smaller boat could go, provided there was sufficient depth of channel, since the independent wheels give exceptional maneuvering power. By adding to the depth of hold the capacity of the boat can be increased from 2,000 to 3,000 tons.

The principal dimensions of the *John Todd* are as follows: Length from stem to after transom, 275 feet; beam, molded, 66 feet; depth of hold, molded, 6 feet; sheer forward, 6 feet 6 inches; aft, 8 inches.

The side and floor frames are 3 inches by 4 inches by 8.5-pound angles forward and 3 inches by 4 inches by 7.2-pound angles aft, spaced 18 inches centers. The deck beams are the same size angles as the forward frames and are secured to the frames by gusset plates, 18 inches by 5/16-inch thick. There are ten floor stringers of 3 inches by 3 inches by 8.4-pound Z-bars, five on each side of the center longitudinal bulkhead, secured and riveted to the floor frames by angle iron clips. There are two rows of stanchions in the hold, 2½ inches by 2½ inches by 5-pound Z-bars spaced every 6 feet to support a heavy deck load. On each side of the hull there is a Z-bar stringer, 3 inches by 3 inches by 8.4 pounds.

The plating is of the best flange open-hearth steel from 55,000 to 65,000 pounds tensile strength. The bow plating and knuckle forward where exposed to wear is 15.3 pounds to the foot; the bottom plating, 12.75 pounds; the sides, 10.2 pounds, and the after stern rake, 7.65 pounds.

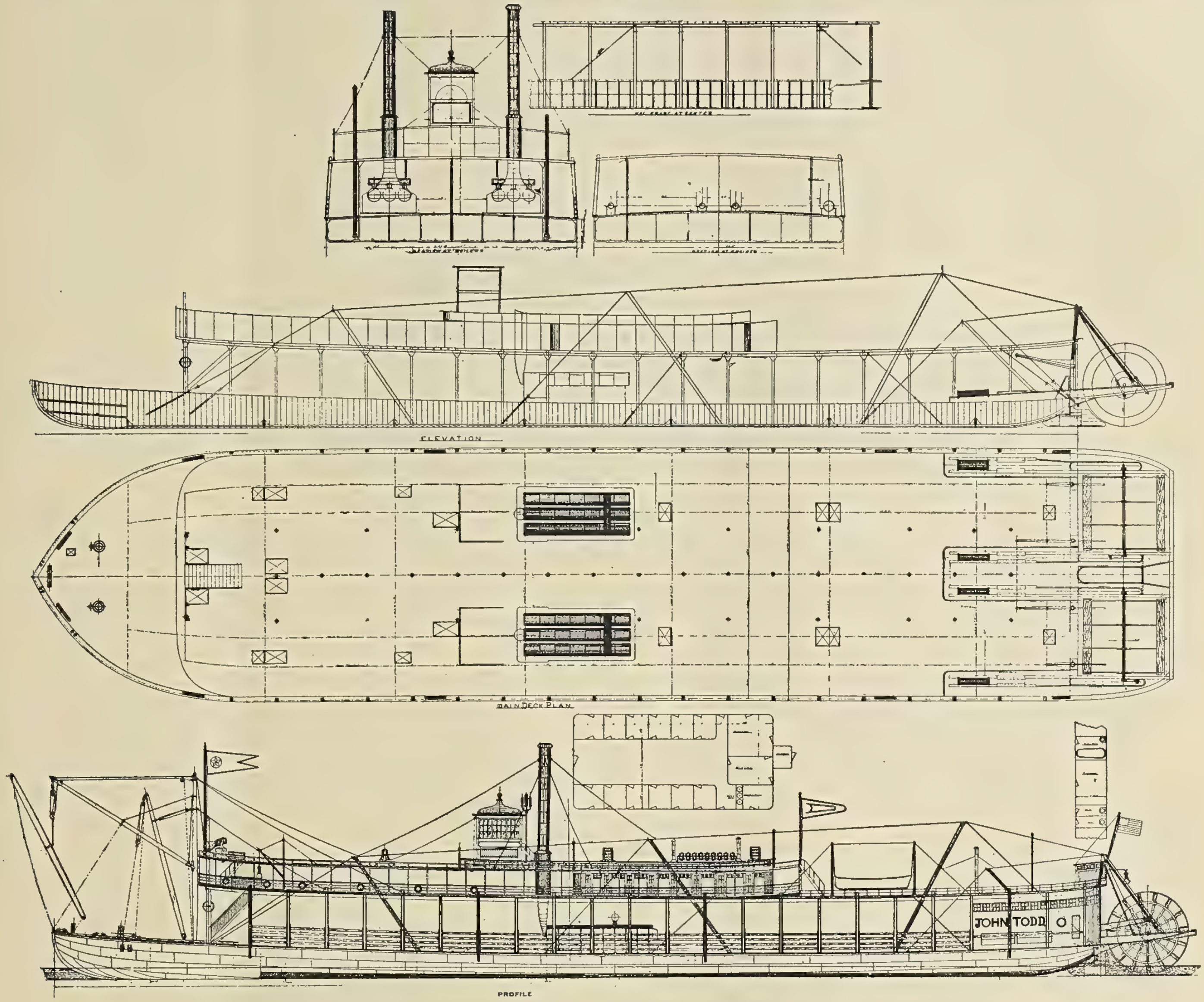
The hull is divided by three fore-and-aft bulkheads, the center bulkhead being of 10-pound plate and the wing bulkheads of 7.65-pound plate, stiffened with 2½ by 2½ by 4-inch angles, spaced every 3 feet and made watertight by Rees' patent steel flanged intercostal. There are also seven transverse bulkheads of 7.65-pound plate, stiffened every 3 feet by angle iron stanchions. The hull is, therefore, divided into 29 watertight compartments. Under the boilers and under the engine beams there is a ¼-inch steel deck and also a 3-inch by ¼-inch plate extends from the stem to the main transom and is secured to the center and transverse bulkheads and deck beams. The remainder of the deck is of 2-inch white pine.

There are four fantails, one on each side and two in the center formed of angle iron and corrugated or checkered plates, extending from the transom to the after-end of the engine beams and secured to the engine beams and jockey beams by plates and gussets. There are four balanced rudders.

The cabin accommodations, as shown in the illustration, are of the regular Missouri River style, designed to accommodate only the crew and a limited number of passengers.

As previously stated, the wheels can be driven by either high-pressure or cross compound engines. If high-pressure engines are used they will be 16 inches diameter and 7 feet stroke. If cross compound are desired, they will be 16 and 32 inches diameter by 7 feet stroke. Each pair of engines drives independently one of the wheels. The wheels are 22 feet in diameter with buckets 20 feet long and 26 inches wide. Steam is furnished by two separate batteries of three boilers each. Locomotive boilers can be substituted if desired.

It is estimated that this boat will have a displacement of 2,500 tons net when loaded to a depth of 8 feet at the stem and 3 feet 6 inches at the stern, or 36 tons to the inch of draft for the first 12 inches, and to increase the displacement as she gradually comes to her full bearing. The estimated weight of material, fuel, etc., is 636 tons, or on a mean draft of 4 feet, 665 tons net, and at a draft of 8 feet forward and 3 feet aft, 1,872 tons net. By loading the boat deeper at the stern the capacity will be largely increased, but the design has simply been worked out according to Missouri River requirements.



PROPOSED DESIGN FOR STEAMER JOHN TODD.

Stern Wheel Steamer Endeavor for the Congo Mission of the Baptist Missionary Society.

The hull and machinery of the stern-wheel steamer *Endeavor,* built for the Congo Mission of the Baptist Missionary Society, were designed to meet the requirements laid down by the missionaries, and both hull and machinery were inspected during progress of Mr. C. T. Williams, the missionary engineer, who came to England from the Congo for this purpose. The Baptist Missionary Society also had the advantage of the advice and assistance generously afforded them by the late Mr. G. L. Watson, of Glasgow, the celebrated naval architect and yacht designer, and, subsequent to his death, by Mr. J. R. Barnett, his parter and successor.

The contract for the whole of the work was placed by the society with Messrs. Salter Bros., launch builders, of Oxford, and they placed the order for the machinery with Messrs. W. Sisson & Company, Ltd., of Gloucester, and also requested them to work out the hull design as far as the structural arrangements, trussing, etc., were concerned.

The general arrangement of the vessel is clearly shown by the illustrations, and, as usual, the hull is well sub-divided into watertight compartments by longitudinal and transverse bulkheads. It may be mentioned that the trussing is of novel design, the vertical pillars being formed of tapered steel tubes, which secure strength and lightness and constitute ventilating shafts for the various compartments. The main tie-bars are connected by turned steel bolts to steel castings securely attached to the pillars and to the main deck and longitudinal framing of the upper deck, an arrangement which proved to be most satisfactory.

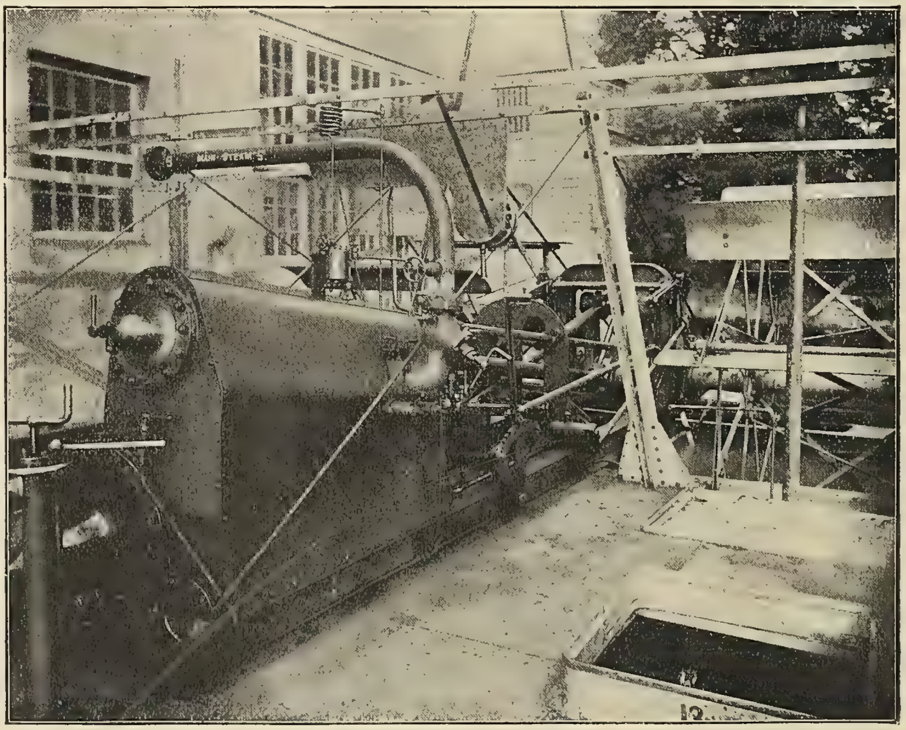
The hull throughout and the main deck are of steel, and the whole of the steel and iron work is galvanized; the upper and shade decks are of teak, the latter being covered with sheet copper. The cabins are of teak and suitably arranged for ventilation for hot climates.

The machinery consists of a pair of W. Sisson & Company's specially designed compound jet condensing engines, arranged on the center line of the boat and having partially superposed cylinders, 11 inches and 22 inches diameter by 48 inches stroke. This is a type of engine which the builders have proved by a good many years' experience to have substantial advantages, such as compactness, lightness and less liability to interference or damage than engines at the sides; also the passage of steam from one cylinder to the other is very direct and the drainage of the cylinders excellent, as they are practically self-draining right through to the exhaust. The crankshafts being coupled only by a drag link are free to take, without injury, a position

BAPTIST MISSIONARY BOAT ENDEAVOR.

out of line with each other if the hull is subjected to any strain or distortion. The channels which form the lower members of the engine framing, in conjunction with the U-shaped steel casting connecting the main bearing brackets (which are also of steel), and the Y-shaped stay from these to the high-pressure cylinder, constitute a stiff and comparatively light framing. The connecting rods are tubular; the valves are of piston type; the valve gear of single-fixed eccentric or Marshall type, and the handling of the engines is thus rendered exceedingly easy. The paddle-wheels are of the feathering type, with a simple and effective form of framing which does not involve the heavy and expensive forgings of the usual form of feathering-wheel framing. The wheel centers are of cast steel.

As before mentioned, jet condensing is employed, there being two double-acting air pumps having automatic suction, and thus without either suction or bucket valves. They are actuated direct by a pair of compound cylinders, whose stroke



ENGINES AND PADDLE WHEELS OF THE ENDEAVOR.

is regulated and motion given to the valve gear by a crankshaft with cranks at right angles, the rods connecting the steam cylinder crossheads to the pump crossheads being double, passing on each side of the crankshaft, the cranks working between them. An automatic expansion shaft governor, formed in the fly-wheel, controls the high-pressure valve and prevents racing under any conditions of load.

The boilers are in duplicate, partly on account of head room, to avoid trespassing on the upper deck room, and partly so as to secure a certain amount of duplication. They are of Sisson type, securing among other advantages uniform length of watertubes, and these are all straight; the water drums are of welded steel tubes pressed into the shape required, thus avoiding any riveted joints except at the two ends. The working pressure is 165 pounds per square inch, and the boilers have the usual accessories, with extra large grates for wood burning, and are fed by duplicate feed pumps of duplex type, or by an automatic restarting injector at pleasure. Suitable valves and connections are arranged so that complete drainage of the watertight compartments can be performed either by the jet condensing pumps above mentioned or by one of the duplex feed pumps. The strainers or rose boxes for all pumps and the injector are arranged at the deck level, with very large copper wire strainers easily accessible for cleaning, and the main injection valves are in duplicate, one at each side. Arrangements are also made for supplying the toilets with water and the bath with either hot or cold water.

The vessel was temporarily erected and riveted up complete with all accessories, the machinery fixed on board, and the trial trip run on the river at Oxford. The whole was then marked for re-erection, dismantled, packed and shipped. Information has been received recently stating that the work has come together with great facility, the re-erection having been quickly performed entirely by native labor, an indication of the excellent workmanship in the hull.

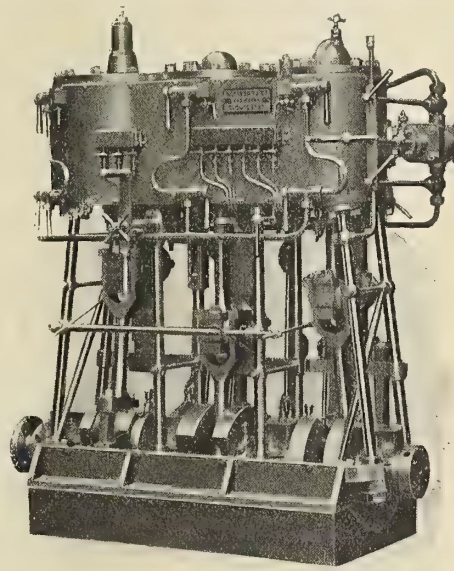
A later report states that the vessel has run over 4,000 miles and proved most satisfactory in respect of speed, carrying capacity, stiffness under all conditions of loading, fuel consumption and ease of handling. The last-named quality is a very valuable one, for navigation on the Congo is beset with many difficulties.

According to a report from Mr. Alfred Stonelake, from Kinshasa, Stanley Pool, the two boilers, each the size of the single (Thornycroft) boiler on an earlier steamer, the *Goodwill*, consume only about the same quantity of fuel (wood) as was used on the *Goodwill*. Instead of two pumps with difficulty feeding the one boiler one pump feeds the two boilers, yet only working about half the time. Instead of the firemen being hard-worked they now have an easy time of it. The engines, too, have received much attention. It is a surprise that engines so small can develop such power and speed. There is a certain vibration of the sponsons to be overcome and then the *Endeavor* will be an ideal steamer. As it is the boat has steamed 2,000 miles without a single worry concerning the engines and boiler.

When the boat was put together temporarily by the builders for her trials the fitting and riveting were carefully and satisfactorily done, and although only about one-half of the rivets were put in there were no leaks during the trials. There was also no difficulty in finally fitting and riveting the vessel in Africa with native labor.

The side paddle-wheel engines are of compound, non-condensing type, having partially superposed cylinders, 9 inches and 13½ inches diameter by 36 inches stroke, with piston valves to both high and low-pressure cylinders. The boilers are of the usual marine return-tube type, 6 feet diameter by 8 feet long, 150 pounds working pressure. The speed of the vessel is 10 miles per hour. The engines were steamed in Messrs. Sisson & Company's shops prior to being sent out to Burma, together with all the steel work and accessories of the hull of the vessel, which was 67 feet 6 inches between perpendiculars by 15 feet molded breadth by 4 feet 3 inches molded depth; draft, 2 feet 6 inches. Complete instructions were supplied to the owners for re-erection and fitting up of the vessel complete in Burma.

An application which has now become comparatively common in connection with a light draft launch is the tunnel arrangement, which enables a screw propeller of suitable diameter to be applied, and thus screw machinery can be utilized for light draft vessels in this manner. When so applied the engines usually run at a high speed, as the propeller diameter is naturally kept as low as practicable so as



TRIPLE-EXPANSION, HIGH-SPEED SISSON MARINE ENGINE.

to reduce the height of tunnel. For such work Sisson's high-speed, double-crank compound and three-crank triple-expansion engines of specially designed light type are very suitable. Either single or twin screw may be arranged for, depending upon the conditions required to be fulfilled, and in such cases the adoption of a watertube type boiler to save weight is advisable.

SHALLOW DRAFT BOATS IN THE PACIFIC NORTHWEST.

The type of shallow draft boats propelled by a stern wheel set athwart the hull, resting on timbers overhanging the transom, has reached a high state of perfection in the Pacific Northwest, and appears extensively on Alaskan rivers. The hulls have very little, if any, dead rise, short rakes astern, and are carried out very full into their forward quarters. This presents the greatest possible bearing surface, and as the weights of materials are kept as light as is consistent with strength and durability, the initial draft is small, rendering them serviceable on streams of shallow depth. Their draft is increased very uniformly per ton of load from light waterline to maximum load line. The less the draft, the less the power required to propel them, a feature which permits them to do some remarkable feats in stemming shallow riffles.

The first craft of this sort built by Joseph Supple, of Portland, Ore., was the steamer *Chester*, a hull 100 feet by 20 feet by 3½ feet, launched in 1895 for service on the upper stretches of the Cowlitz River, a tributary of the Columbia, draining Southwestern Washington. This boat, when launched with

machinery and equipment installed, drew only 5 inches of water. Red cedar was used extensively in her framing, and her timbers were of such small dimensions that many "wiseacres" among steamboat men predicted that she would fall to pieces on her trial trip. She is still in service, however, and bids fair to last several years longer.

FIG. 1.—ONE HUNDRED FOOT STEAMBOAT, WHOSE DRAFT AT LAUNCHING WITH MACHINERY AND EQUIPMENT WAS 5 INCHES.

She has a boiler of locomotive fire-box type and a pair of 6-inch by 24-inch stern-wheel engines. A picture has been taken of her when she was tied to a tree on the bank and a dray had driven into the stream and was receiving freight from her fore deck. The water covered scarcely more than the fetlocks of the horses. She is speedy and easily handled, and her lasting qualities have been a source of wonder to her builder and owners.

Her hull is pliable to a considerable extent, and is held in shape by a simple system of hog chains, which hold up the

FIG. 2.—THE TANONA, AN ENLARGED CHESTER.

boiler, stern and fore deck and hold down the places where the hog posts are stepped. All of her fore-and-aft timbers and planking are rendered continuous by securing the butts together with straps of the same size scantling fastened to each section with carriage bolts. The hull will bend without disturbing any of the joints or casting out the calking materials. In passing over a sand bar carrying less water than her draft, when headed upstream, her fore quarter will rise onto the bar, and the suction of her stern wheel will soon draw out the sand and permit her to slide over. She has been replanked several times, as her bottom wears out from contact with the bars.

Since the discovery of gold on the Yukon there has been a great demand for light-draft boats prepared for shipment knocked-down to a point where they could be reassembled for service. Over twenty boats of this type, varying from 80 feet to 150 feet in length, have been built at the Supple shipyard, and they have all been modeled after the lines of the *Chester*, and have had timbers of proportionate dimensions. As these boats received rough handling and were used on long, difficult runs, they were built a little heavier than the *Chester*, and their draft was increased about 50 percent over hers. It was also found necessary to reinforce the butt straps on the top sides and sheer with plates of No. 10 galvanized steel, which served as a common washer for the strap bolts and added a great deal of strength to these parts.

A novel feature was devised to assist in passing over the swift shoals, consisting of a set of spars which were worked from each side of the fore deck and from each end of the transom. It is hard to describe just how these spars were operated, but the effect was much the same as though a person lying flat on his face would hook himself along with his elbows. The part of the hull bearing heaviest on the bar would bend up, so that perhaps each end would be afloat if the bar were narrow.

These spars are used a great deal, and the hulls have to be replanked every year. In most cases the bottom planks and knuckles are fastened with carriage bolts, and the replanking can be done without damage to the frames, as is the case where spikes are used. In all cases, except one, the top frames have been made of Douglass fir knees, from 1¼-inch to 1¾-inch faces, according to the size of the boat. The one exception was in the steamer *Willie Irving*, which was taken over the Skagway trail and reassembled on Lake Bennett. Her frames were of bent oak, as her owner intended to improvise sleds with them to transport the materials over the White Pass. The wagon road was finished in time to avoid this rough usage of the frames, however, and the first toll collected on this road was on these materials.

The *Irving* was the first steamboat taken down the Yukon through the White Horse Rapids and Miles' Canyon. She was operated two full seasons and part of a third on the run between Dawson and White Horse, and is said to have earned over $250,000 (£51,500) in that short time. As she was only 80 feet by 20 feet in size and made only a dozen trips or so in a season, her earnings are a good gage of the high rates charged for transportation in these pioneer days. She was wrecked in an accident and her remarkable career ended. When shipped, no part or package was over 20 feet long, nor too heavy for two men to carry, except the shaft for her stern wheel, which was a hollow tube weighing about 400 pounds. The boiler was of the watertube type and easily made in sections. The engines were built entirely of cast steel and wrought iron at the factory of the Marine Iron Works in Chicago. She was by far the fastest boat on her run, a fact which, no doubt, added largely to her earning capacity.

Fig. 2 shows the steamer *Tanona,* which was built in 1904 by Joseph Supple from plans made by Capt. Jas. T. Gray, enlarged from measurements taken by him on the steamer *Cluster*. The hull was erected at the Supple shipyard. with deck frame and posts and chains removed. This boat is still on the Fairbanks run, and is claimed to be the swiftest craft of her size in the Yukon district. She is 150 feet by 30 feet.

Some idea of the rapid work performed in reassembling may be had from the fact that the *Tanona* was on her way fully loaded in twenty-one days after her parts reached St. Michaels by steamship. Fig. 2 shows her loaded with 180 tons of freight, and her draft is 38 inches forward and 30 inches aft. Without load she drew 16 inches. Her sparring rig had not been installed when this picture was taken.

In conclusion it should be noted that a successful shallow-draft boat must have a light and timber hull, with as full lines as possible, and all parts must be so constructed that they are pliable, yet strong, and cannot be disarranged by working. While a flat-bottomed boat with side wheels or a propeller boat with tunneled twin screws may give good service for such severe services as have been described in this article, the stern-wheel type seems to give the best results.

THE BLUFF CITY, A TYPICAL LARGE MISSISSIPPI RIVER STEAMER.

THE INDIANA, A TYPICAL OHIO RIVER SIDE-WHEELER.

THE STEAMERS BLUFF CITY AND INDIANA

The steamer *Bluff City*, built expressly to meet the low-water conditions of the Mississippi River, is considered a very able representative of the light-draft stern-wheel type of river boat. She was designed to ply the Mississippi River and all points between St. Louis (Mo.) and New Orleans (La.), a distance of 1,200 miles. Her dimensions are 225 feet length, 42 feet beam, and 6½ feet depth of hold. The hull construction is carried along the lines of strength and light draft.

The power plant consists of a battery of four boilers, 26 feet long, 44 inches in diameter, each containing four 7-inch and two 11-inch flues. The boilers furnish steam for two horizontal high-pressure cylinders, 20 inches in diameter by 8 feet stroke, of the balanced lever type, with California cut-off, turning at 18 revolutions per minute one large stern paddle

wheel, 24 feet diameter, with buckets 27½ feet long and 28 inches wide. Auxiliary engines operate double capstans forward and aft, also freight hoisters and two stages, 50 feet long by 6 feet wide. The stages are used entirely in loading and unloading cargo. Coal for the boilers is carried forward in bunkers, where it can be quickly and easily passed to the furnaces.

From the main deck forward rises the main stairway to the second or boiler deck, on which are the grand saloon or cabin, staterooms, etc. The cabin is painted a pure white and has thirty-two staterooms, accommodating about eighty passengers. It is 156 feet long, the social hall forward measuring 14 feet by 28 feet. The gentlemen's and ladies' saloons, 13½ feet wide, together with the bar, office, barber shop, etc., are on this deck.

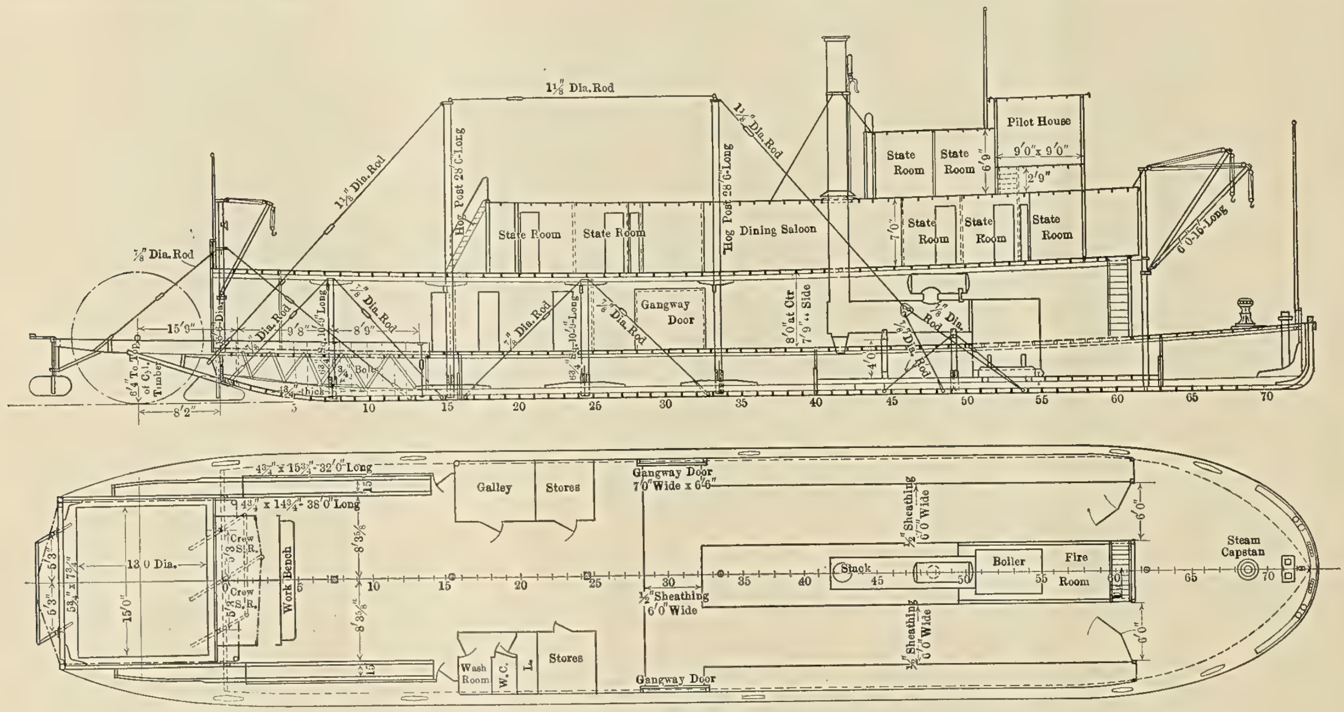
The "texas" is 80 feet long and contains ample and well-furnished quarters for the crew.

the pillow blocks and crossheads are of cast steel. A complete electric plant is situated in the room just aft of the boilers. The hull is of very light construction, but strongly put together, her model, small depth and breadth of beam insuring the necessary light draft. On her trial trip she drew at the point of greatest immersion, at the stern, just 33 inches of water.

Cabin accommodations are provided for about 150 passengers, the rooms being arranged on both sides of a large, long, roomy saloon cabin. All the staterooms are equipped with electric lights, lockers and the usual accommodations.

All the freight that is handled is placed on the main deck, where it is readily accessible and can be moved quickly. It is taken aboard by means of a swinging stage, 40 feet long and 6 feet wide, and is operated by steam.

Both the *Bluff City* and *Indiana* were built by the Howard Ship Yards Company, at Jeffersonville, Ind.



INBOARD PROFILE AND DECK PLAN OF THE ALASKAN RIVER STEAMER TONSINA.

The Ohio River steamer *Indiana* is a typical side wheeler of very light draft. She is one of three passenger and freight packets plying the Ohio River and making trips between Cincinnati, Ohio and Louisville, Ky. Her principal dimensions are as follows: Length, 285 feet; beam, 42 feet; with an extreme width of 80 feet and 6½ feet depth of hold.

The *Indiana* has three decks, the main, cabin or boiler deck, as it is termed, and a hurricane deck. She has a battery of five boilers, 26 feet long, 42 inches in diameter, each of which contains two 15-inch flues. The boiler shell is .28 inch thick; propulsion is by two horizontal high-pressure engines, 25½ inches in diameter by 8-foot stroke, which drive two paddle wheels, 28 feet in diameter, with buckets 15½ feet long and 30 inches wide. Ordinarily the wheels operate at 20 revolutions a minute. The average steam pressure is about 175 pounds. The fuel, coal, is carried on deck in a large bunker, or compartment situated just forward of the boilers. The average consumption of coal, in making a round trip of 300 miles, is about 1,700 bushels. The average speed of the boat is thirteen miles per hour. Her engines are of the high-pressure balance lever type with cut-off, with a cam from main water wheel shaft. The piston rods and wrist pins are of wrought steel.

ALASKAN RIVER BOATS.

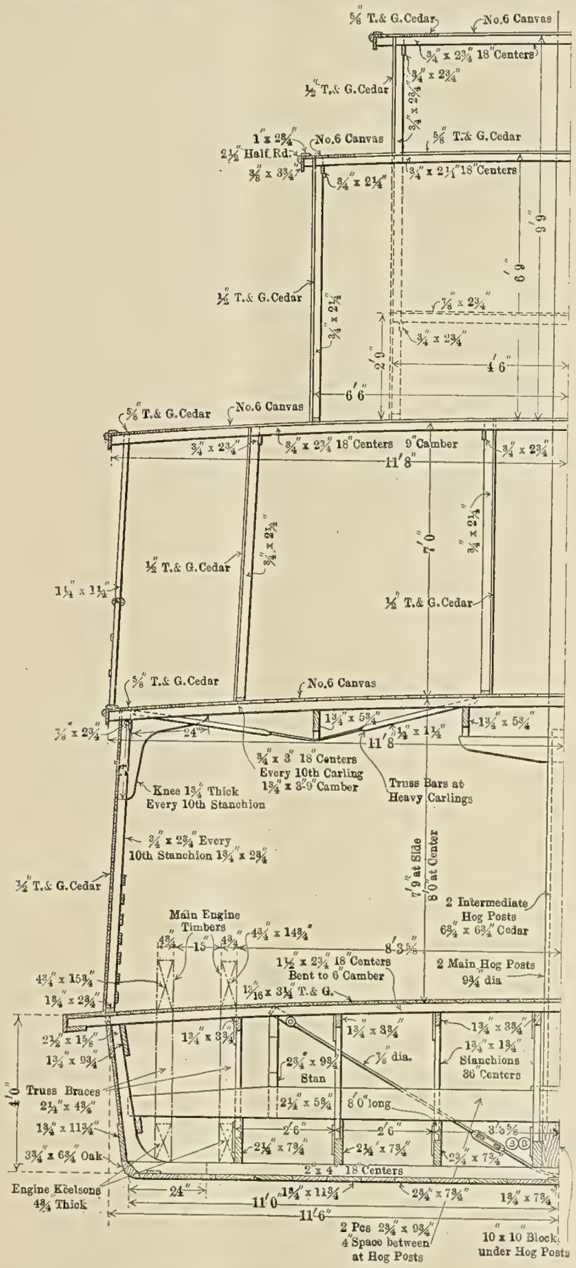
Three stern-wheel river boats, the *Tonsina, Nizina* and *Gulkana,* were built by the Moran Company of Seattle in 1909 for carrying passengers and supplies up the Copper River in Alaska during the construction of the Copper River and Northwestern Railway. They were similar in design and construction, but of different sizes, the *Tonsina* being 120 feet long, the *Nizina* 110 feet long, and the *Gulkana* 80 feet long. They were of very light construction, and, of necessity, of small draft, consequently they had to be shipped "knocked down."

The keel, stem, frames and beams were all erected in the yard, and the garboards, bilge and sheer strakes fitted to them and bolted in position. The entire structure was then carefully marked and taken down for shipment, being permanently erected after arrival at Alaska. As the three boats were all of practically the same proportions, the following description of the *Tonsina* will serve for all three:

The watertight bulkheads were three in number, located one forward of the boiler hatch, one near amidships, and one under the engine room, of vertical cedar ceiling, in two thick-

nesses, with light canvas between and extending to within 24 inches of the deck. A freight house, 102 feet long by 8 feet high, a cabin on the boiler deck, the pilot house and "texas" comprised the superstructure. The freight house, it will be noted, was of ample size. On the main deck were located the crew's quarters, oil lockers, storeroom, toilets and wash room.

The cabin on the boiler deck contained a dining room, galley, locker, eight state rooms, a meat locker and the cook's



MIDSHIP SECTION OF THE TONSINA.

room. The "texas" contained four state rooms; all decks were covered completely with canvas. Life lines of flexible galvanized wire extended from the forward end of the freight house to the stanchions on the fan-tail at each side of the boat.

A reversible steam capstan was fitted on the main deck forward, its principal object being to warp the vessel up-stream in a swift current by winding in a line made fast to a tree or stump on land. Leads were also run to the sparring rig aft for lifting the hull clear of a sandbar in case of grounding. Her general equipment was in accordance with the United States Inspection Laws for a boat of her kind and service, and included capstan bars, snatch blocks, warehouse trucks, pike poles, with and without hooks, peavies, handspars, cross-cut saws, pole and ordinary axes, etc. She was provided with a complete outfit of oil-burning lamps in lieu of electric light, and the cabin was heated by an airtight wood-burning stove.

The propelling machinery consisted of one pair of piston-valve stern-wheel engines, 11 inches by 60 inches, with independent cut-off, driven by one locomotive fire-box boiler, with an allowed working pressure of 225 pounds per square inch, and equipped for burning either wood or coal. The auxiliary machinery consisted of two outside-packed feed pumps, one fire and sanitary pump, one boiler-testing pump and one feed-water purifier and heater. Signals from the pilot house to the engine room consisted of the usual gong and jingle bells and speaking tube.

The wheel was 16½ feet diameter outside of the rim irons, with buckets 2 inches by 18 inches by 19 feet 6 inches, mounted on a hollow nickel steel shaft, with wrought iron bedplates, these latter being designed for a considerably higher working pressure than the allowed boiler pressure for extra safety factor. There was also provided one Clinton "Nigger," with 6-inch by 8-inch double engine, with steel spools for the use of wire line.

A Shallow-Draft Houseboat for Southern Waters.

The Merrill-Stevens Company, of Jacksonville, Fla., has recently built for Mr. W. F. Coachman a 48-foot houseboat for service in Southern waters. The general dimensions are: Length, 48 feet; beam, 16 feet, and depth of hull 3 feet. The house is arranged with a cabin or living room forward, with curved glass front. This room also serves as a dining room,

48-FOOT TWIN-SCREW HOUSEBOAT.

the table being round, with drop leaves. The passage way running from this living room to the galley also opens into the two suites, one on either side. Each of these comprises two staterooms and a toilet. The galley has a shipmate range, sink, with running water, and a refrigerator built in the boat. The novel feature of this is that the ice compartment is surrounded by an air passage and is entirely separate from the food. There are also shelves, racks, etc., for dishes convenient for the cook. In fact, many conveniences which are commonly only secured on a large yacht have been included in the equipment of this boat.

Aft of the galley are the engine room and bunks for the crew. There are two Sterling engines of 25 horsepower each. These turn twin screws 19 inches diameter, making about 600 revolutions per minute. From one engine is belted a dynamo, supplying current for the lighting either direct or through a storage battery. The engines are operated either from the engine room or through levers by the pilot either at the wheel in the living room or from the upper deck. This makes it possible for one man to operate the boat if necessary.

The seats on the upper deck are principally covers for the tanks, one gasoline, one fresh water, and one circulating water from the engines to be used in the toilets. The hand fire pump will operate to fill from the surrounding water, the overhead tank, or pump the bilge or wash down decks.

The upper deck, with awning, makes a delightful place to sit in any weather. The awning cover being painted green protects the eye from the sun glare.

The boat was designed for light-draft service and registers 15 tons. She makes about 9 miles an hour, and is quite free from vibration. The exhaust is muffled and leads out astern just above waterline. The whole finish is designed with a view of eliminating polishing. The woodwork is all white, except overhead. The metal work is galvanized wherever possible. The outside wood on the house part is varnished. This is not prominent, as the windows take up nearly all the space. Each window has a drop blind. The doors are blind doors wherever possible. There is free ventilation over each partition between the cabins. The stairs from the living room to the deck above are covered with a hatch when desired. There are electric bells from the galley and engine room to the living room and deck. The whole equipment is designed especially for the comfort of the owner and guests in Southern waters.

TANDEM COMPOUND STEAMBOAT ENGINES.

The illustration shows a 12-inch by 26-inch by 72-inch tandem compound condensing engine as constructed by Gillett & Eaton, Lake City, Minn., for a stern-wheel Government river boat. The engine is fitted with Gillett's balanced valve with variable cut-off for both high and low-pressure cylinders, operated by the Gillett & Eaton independent inside valve drive.

The cylinders are made from first class close-grained cast iron properly machined. The low-pressure cylinder is placed aft and keyed by the aft lug to steel keying plates, which fasten directly to the cylinder timbers. The forward end of the low-pressure cylinder is placed on steel holding-down and leveling plates. The high-pressure cylinder is attached to the low-pressure by a steel connecting bracket, which is cast in one piece with both the low and high-pressure cylinder heads. The high-pressure cylinder is not fastened by lugs, but simply by an auxiliary support on the bottom.

The piston head for the high-pressure cylinder is of the solid type with two snap packing rings. The low-pressure piston head is of the bull ring type constructed in parts, thus arranging for ease in caring for or renewing the rings. The driving spider is shrunk and riveted on. The high-pressure head is made a taper fit and secured with a nut.

The piston rod for the two cylinders is in one piece, made of steel and turned to 4½ inches diameter for the low-pressure and 3 inches for the high-pressure. The after end is threaded to fit into the crosshead.

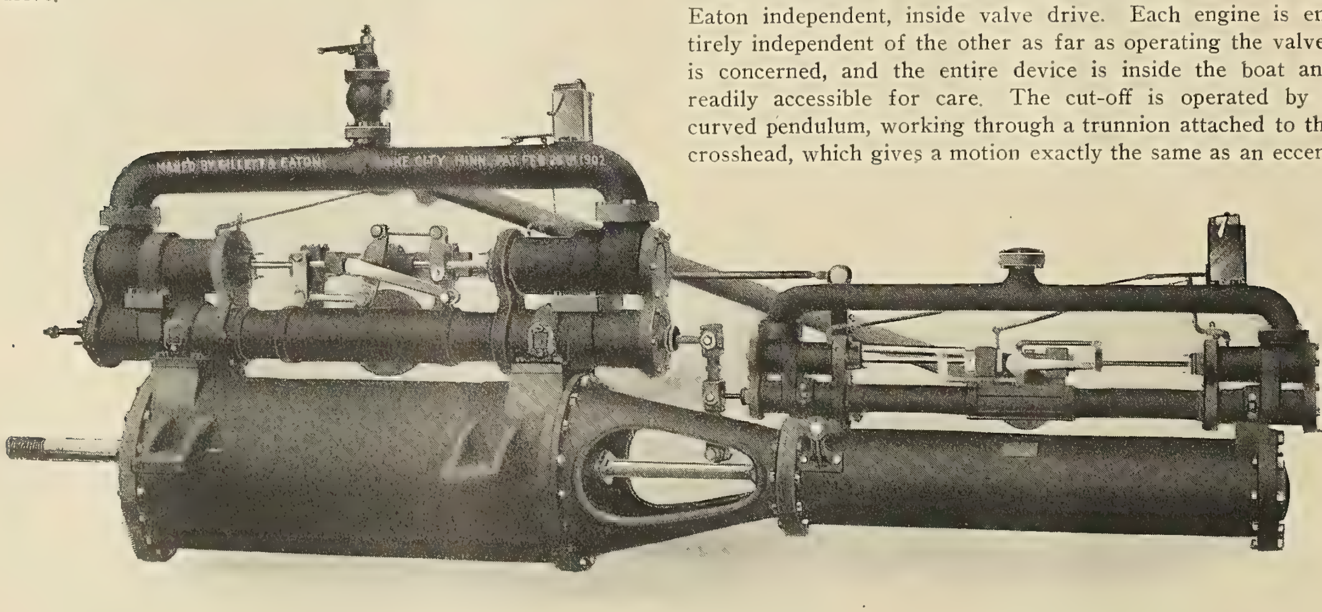
The main body of the crosshead consists of two steel sides, shrunk and riveted to the crosshead pin. This construction admits of the sides being threaded and clamped on to the rod. As already stated, the end of the rod is threaded; thus the adjustment for equalizing the pistons may be easily made, and at the same time a secure fastening is obtained. The crosshead pin is 4¾ inches by 5 inches and of steel. The gibs for the crosshead are of bronze composition, consisting of 77 parts of copper and 8 of tin and 15 of lead. This metal is now the standard bearing metal of the Pennsylvania Railroad, and all brasses for these engines are made of this alloy. The gibs are also babbitted with Hodge's best babbitt.

The engine slides are of cast iron fitted directly to the cylinder beams without separate bed plates.

The pitman ends are of Norway iron forgings fitted with bronze alloy boxes. The ends of the pitman are fitted with extra or king bolts outside of the key and gib.

The pillow blocks are of steel with bottom and quarter brasses. The wheel shaft is of hexagonal forged steel, having a minor diameter of 9½ inches. There are five wheel flanges made of steel, each with 14 arms. These flanges are wedged to the shaft according to the regular Mississippi River approved method. The cranks are of cast steel.

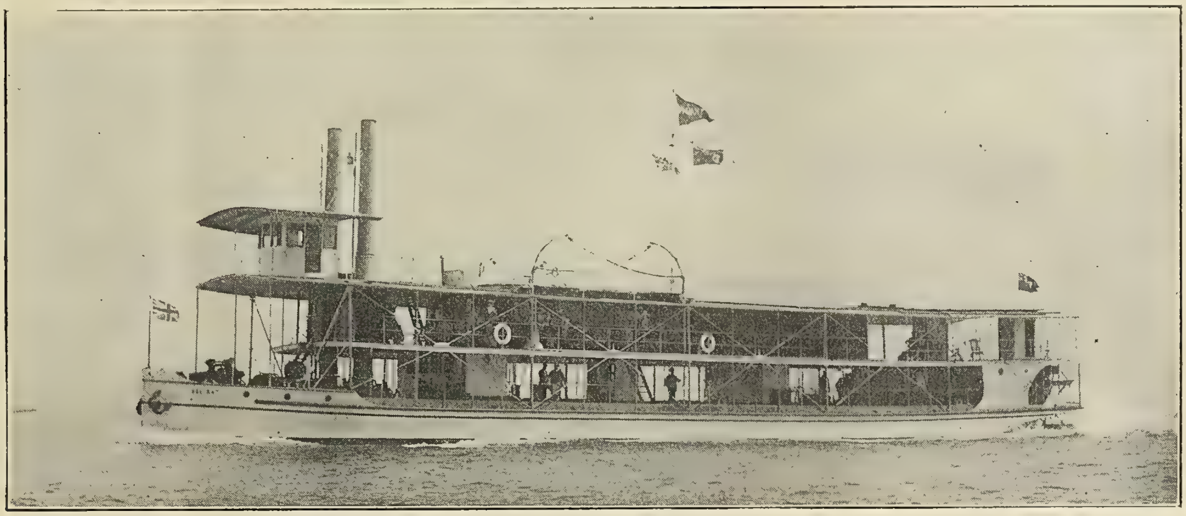
The valve drive is of a patent type, known as the Gillett & Eaton independent, inside valve drive. Each engine is entirely independent of the other as far as operating the valves is concerned, and the entire device is inside the boat and readily accessible for care. The cut-off is operated by a curved pendulum, working through a trunnion attached to the crosshead, which gives a motion exactly the same as an eccen-



GILLETT'S BALANCED VALVE VARIABLE CUT-OFF STEAMBOAT ENGINE.

tric set opposite to the crank. The main valve is operated by the oscillating frame, one side of which is a slide over which operates a sliding connection to the center line of the pitman.

In these engines the reverse is operated by a steam-shifting device. The cut-off for both high and low-pressure cylinders is arranged to work together and also their relation to each other is adjustable, so that one may be adjusted independent of the other, thereby permitting a maintenance of the most desirable pressure in the low-pressure cylinder. The ordinary working steam pressure is 200 pounds to the square inch, and the port area throughout is of such size as to permit the engines to work up to 30 revolutions per minute without exceeding a steam or exhaust velocity of 5,000 feet per minute.



STERN-WHEEL STEAMER VALIANT, FOR SERVICE IN SOUTHERN NIGERIA.

SEAMLESS STEEL SHALLOW-DRAFT MOTOR LAUNCH.

The method of manufacturing the shallow-draft launches, built by the Seamless Steel Boat Company, Ltd., of Wakefield, is the same as that used for the company's standard type of ship's lifeboat, i. e., each side of the boat is made of one sheet of steel, which is heated in a furnace and then pressed into shape between dies in a large hydraulic press. In shallow-draft launches, however, which are 40 feet by 8 feet by 3 feet 9 inches, the usual type of T-bulb keel bar, to which the sides are riveted, is dispensed with and a flat keel with inside keelsons is substituted, effecting a saving of 3 inches in the draft. The "tunnel" type of stern is adopted to contain the propeller, which would not otherwise be sufficiently immersed and would consequently be inefficient. Inside the tunnel the action of the propeller drives out the air and raises the water until the tunnel is filled. With a gasoline (parafine) motor of 15 brake horsepower the launch attains a speed of 9 miles per hour.

The motor is of the 2-cylinder 4-cycle type, with magneto ignition, free wheel starting gear, water-cooled exhaust silencer, etc., and runs at full load with a consumption of 1½ gallons per hour, the ordinary Russian or American petroleum being used.

A teak cabin is placed in the forward end, with two side seats, which slide out when required to act as sleeping berths, with spring mattresses and reversible cushions. A small lavatory, with wash basin, fresh-water tank, etc., is fitted, together with a water-closet of the ordinary yacht's type, in a separate compartment. The roof of the cabin forms part of an upper deck, which is used as a promenade, being fitted with hand rails and ladder at the stern. A steering wheel is fitted on the forward deck. The woodwork throughout is of teak, with watertight steel bulkheads at after end of the forward deck and each end of the motor compartment.

An English Boat in Southern Nigeria.

Messrs. J. Samuel White & Company, Ltd., East Cowes, Isle of Wight, have built a number of shallow draft vessels, the latest of which, embodying all of the best features of design, as worked out by this company, is the *Valiant,* built for service in Southern Nigeria. The designs for this boat were made primarily by Mr. T. Henry Wells, consulting engineer and naval architect of 63 Queen Victoria street, E. C. The details, however, were worked out by Messrs. J. Samuel White & Company. The general arrangement of the boat is evident at a glance from the photograph shown herewith. She is 145 feet long and 27 feet broad, and with a load of 40 tons the draft is 2 feet and the speed 10 miles per hour.

The engines are of the triple-expansion horizontal type of 320 indicated horsepower, and steam is supplied by White-Forster watertube boilers. The suitability of this type of boiler for this service is emphasized by the fact that with native firemen no difficulties have been experienced, and the vessel has been run successfully and economically. There are two paddle wheels, not, however, working independently.

The accommodation consists of eight cabins and officers' salon, with the usual offices, etc., and arrangements for carrying troops.

The result of the first engineering competition of the United States navy, which lasted from July 1, 1909, to June 30, 1910, has been made public, and the *Nebraska* and *Preble* are announced as the trophy winners in the battleship and destroyer classes, respectively. This is the first competition of its kind conducted in the United States navy, and prizes of an aggregate value of $5,000 (£1,030) were awarded to the winners. The saving in coal consumption alone during the year as a result of the economy attendant upon this competition is estimated at about $1,000,000 (£205,000). Large savings have also been made in repairs, in the consumption of lubricating oil and other supplies.

STUDY VANADIUM

Vanadium Crucible Steel Cylinder Casting for Torpedo.

Physical Properties.

Elastic Limit	65,000 lbs.
Tensile Strength	80,000 lbs.
Elongation in 2"	22%
Reduction of Area	43%

This cylinder was nicked along both sides with cutter, and then flattened under a steam hammer without breaking. The thickness of the walls of this cylinder is 3/16 inch or 33-1/3% less than the thickness of the cast iron cylinders formerly used.

Vanadium is as old as the world.

It is a chemical element refined from the ore. Once more costly than gold, it is now sold by the ton. It is the open secret that explains the fine qualities of the Swedish iron and steel. Every pound of high priced tool steel that comes from Europe contains Vanadium. It is impossible to make the tool steel required by modern conditions without Vanadium. It is also impossible to reach the highest efficiency, life and strength in your castings, forgings, springs, tools and machinery parts without using Vanadium. Therefore study Vanadium, "The Master Alloy."

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TUNNEL BOATS.

The use of screw propellers for the propulsion of shallow-draft vessels has been investigated very thoroughly by Yarrow & Company, Ltd., Scotstoun, Glasgow, and the results of these investigations were embodied in a paper read at the spring meeting of the forty-fourth session of the Institution of Naval Architects by Mr. A. F. Yarrow. The following information is quoted from Mr. Yarrow's paper, and, although perhaps it is familiar to many of our readers, yet it gives a good idea of the design, construction and efficiency of this type of boat, and is well worth keeping in mind in considering the shallow-draft boat problem:

Referring to Fig. 1, which represents a section through a vessel of this type, such as we frequently build, the upper part of the tunnel is considerably above the waterline, thus enabling the diameter of the propeller to be greater than the draft of water. We adopt, for example, in a boat drawing a foot, propellers of 2½ feet diameter, and in a vessel drawing 2 feet, propellers of 4½ feet to 5 feet diameter. When the vessel is at rest the water level inside the tunnel is naturally the same as it is on the outside; but, when the propeller begins to revolve, the air which is enclosed in the upper part of the tunnel is forced out and replaced by solid water. By this means it will be seen that a large propeller, capable of utilizing considerable power, can be used in combination with a shallow draft. There will be an increased resistance to the forward motion of the vessel, due to the action of the screw in reducing the pressure of water at the inclined part of the tunnel forward of the propeller, and this increased resistance is common, more or less, to all screw ships, but it is probably proportionately greater in this class of vessel than in those where the propeller is in the usual position. There is also a loss of efficiency, due to the resistance of the inclined surface of the tunnel aft of the propeller.

The inclined portion of the tunnel aft of the screw should be as nearly horizontal as possible, so as to diminish this resistance; but this would increase the length of the tunnel and involve greater draft, because to augment the capacity of the tunnel below the waterline is just so much loss of displacement, and the water in the tunnel above the waterline is equivalent to just so much load carried when the boat is at rest and the tunnel full. It is, therefore, desirable to reduce the capacity of the tunnel to a minimum, as considerations of draft render it not always practicable to select a favorable inclination at the after part of the tunnel without causing losses, such as those alluded to above, which may be even greater than if a steeper inclination of tunnel be adopted. The tunnel is sealed on all sides, this being necessary, because, when once the air is forced out, it must never be allowed to pass in, or the propeller would not be working in solid water. As regards the forward part and the sides, there is no difficulty in sealing the tunnel satisfactorily, but the extreme after part of the tunnel should be arranged to come two or three inches below the waterline, i. e., sufficiently below the surface to exclude the air. To make the operation clear, I would draw your attention to the model, showing the after part of a launch. This, however, does not demonstrate the system favorably, because the boat is at rest, and the sweeping away of the bubbles of air is not so rapidly effected as when the boat is moving; in fact, in actual full-size examples the action of expelling the air is almost instantaneous. It will be seen that when the motor driving the screw is set in motion the air is driven out of the tunnel, and the propeller then works in solid water.

It has been stated that vessels *Sheikh* and Sultan, which we built in this manner for the Nile, did not tow efficiently, and that the sternwheelers, which we and other firms built for the previous Nile expedition, towed better. That was no doubt perfectly true, and may lead to the impression that vessels built on this plan are not efficient for towing. Such, however, is not the case. As a matter of fact, they are very efficient for towing, provided the propellers are made sufficiently large. With a view to securing the maximum efficiency for speed when not towing, the propellers in all these boats were made of small size. Had the *Sheikh* and *Sultan* been intended for towing, we should, no doubt, have adopted propellers of a diameter at least 50 percent greater than we did. I mention this fact, in passing, to avoid the impression that vessels on this plan do not tow well.

I now come to a departure which we have recently made in the design of these tunnel vessels, and which has added considerably to their efficiency. It will be remembered that the after part of the upper portion of the tunnel, which is inclined downwards towards the stern, is a source of resistance. As already explained, it is compulsory when starting that the after extremity should be below the water in order to prevent air gaining access to the interior of the tunnel. Now, experience has shown that once the boat is under way the after extremity of this tunnel, when full, may be above the surrounding water, because the rush of water out of the tunnel in a sternward direction is such as to prevent the air passing in; in fact, the after part of this tunnel may be 6 or 8 inches higher than the water level without risk from this cause, at the same time improving the result, due to reduced resistance of the inclined surface. It has been shown that the after part of the tunnel should be below the waterline when the vessel is starting light; but if it were fixed in that position it would be unnecessarily low down when the vessel is loaded, thereby involving greater resistance than if the after part of the tunnel terminated at a level sufficient for the loaded boat.

In our more recent vessels of this kind, we have made the upper part of the tunnel, from the propeller to the stern, hinged in such a way that it can be raised and lowered to any desired height, either by machanical means or automatically. Figs. 1 and 2 fully explain the system. Fig. 1 shows the position of the hinged top, or flap, when the boat is light, drawing 11 inches, and Fig 2, when the boat is loaded, drawing 28 inches. It will be seen at a glance that when loaded, if the after extremity of the tunnel were in the same position as it is when light, it would involve a greatly increased resistance, while by raising the top of the tunnel the water has a clear passage open to it to freely pass away in an opposite direction to that in which the vessel is traveling. The gain by the raising and lowering of this flap is illustrated by diagrams in Figs. 3 and 4. When the launch is light, drawing 11 inches with the same power, the speed is increased from 9.2 miles an hour with the flap down to 10 miles an hour with the flap up; and when the draft is 28 inches, loaded with 20 tons, the speed is increased from 6.9 miles an hour with the flap down to 8.25 miles an hour with the flap up, the power at both speeds being the same. As might naturally be expected, the increase of efficiency due to the lifting of the flap is greater when the boat is loaded, the lower speed in both cases being what they would have been if there had been no adjustable flap, clearly showing the advantage of the flap.

Now I propose to describe a set of experiments carried out with a view to test the towing efficiency of this method of propulsion. We built for the Trent Navigation Company a twin-screw tug called the *Little John*. It was 80 feet in length by 14 feet 6 inches beam; minimum draft, with steam up, 22 inches; displacement about 40 tons. Each screw was driven by a single inverted engine, 10 inches in diameter by 10 inches stroke; high-pressure, locomotive boiler. The dimensions of the tug were determined by the size of the locks and the depth of the river.

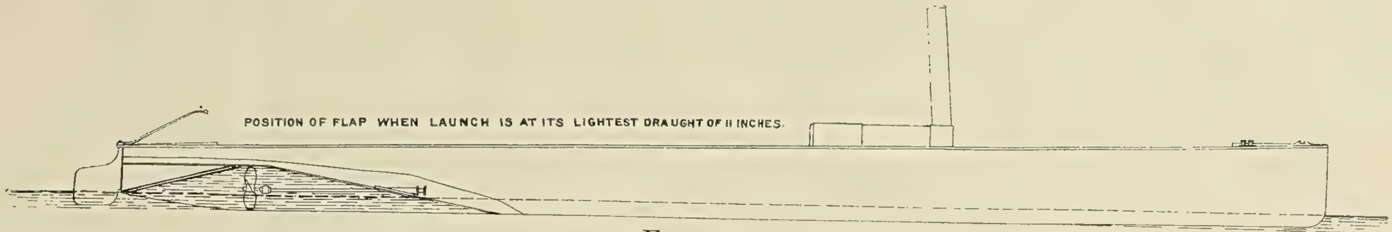


FIG 1

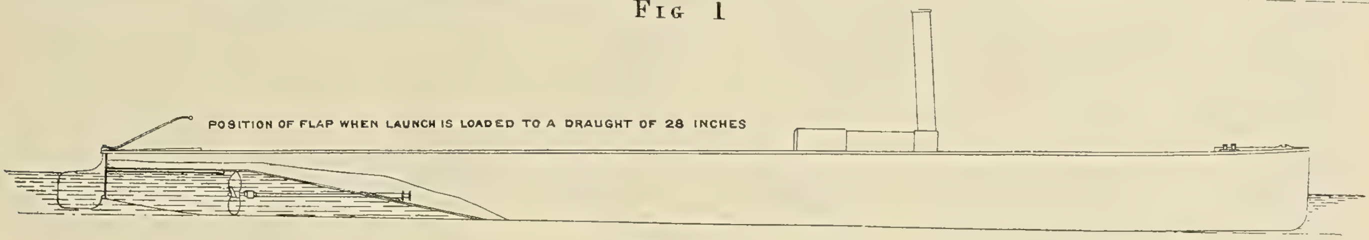


FIG 2.

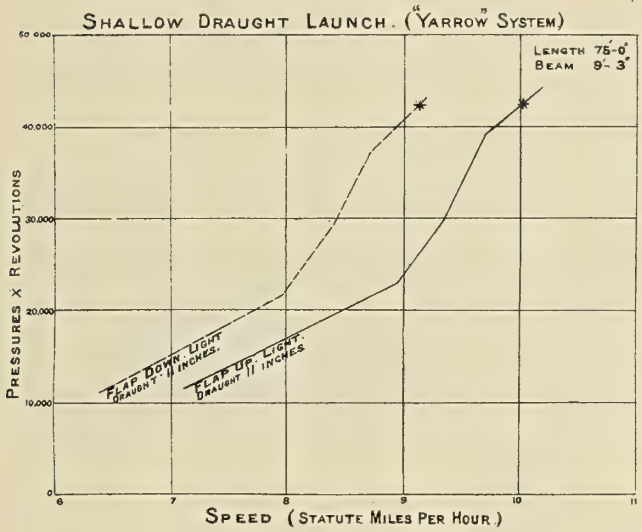


FIG 3.

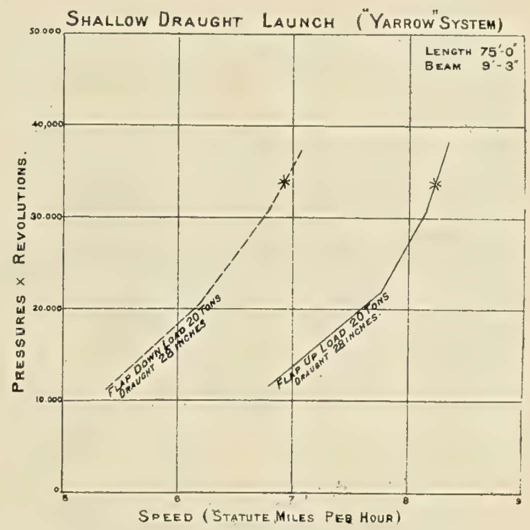


FIG 4

YARROW'S PATENT HINGED FLAP FOR TUNNEL BOATS, AND CURVES SHOWING EFFECT OF THE DEVICE ON SPEED.

Up to the time of our building this boat the Trent Navigation Company had experienced much difficulty in dealing with their traffic. Side-wheelers were found too wide to pass through the locks owing to the paddle-boxes. A twin-screw boat, with propellers in the usual position, proved very inefficient; a stern-wheeler was also tried, and found unsatisfactory. The company therefore determined to make a trial of the tunnel system, and the *Little John* was built. She has been in constant work for several months, and has proved conclusively that this system of propulsion is well adapted for towing purposes, enabling a considerable amount of power to be obtained and efficiently utilized in a small boat with a very limited draft.

Through the kindness of Mr. Rayner, the engineer of the Trent Navigation Company, an excellent comparison was made between our tunnel tug, the *Little John,* and a side-paddle tug, the *Robin Hood,* which the company have for towing on the lower part of the river below the locks, where the river is deeper. This latter vessel had feathering floats, machinery by Penn, and was undoubtedly a good example of this type of vessel, considering the size, draft and power. She had a length over all of 91 feet 6 inches by a beam of 14 feet; breadth over paddle boxes 24 feet, draft 3 feet, displacement about 55 tons; two cylinders, 18 inches diameter by 27 inches stroke, condensing; wheels 9 feet 2 inches over the floats, 3 feet 10½ inches wide; return-tube marine boiler. It will therefore be seen that the *Robin Hood* made a fair comparison with the *Little John.*

In order to test the comparative efficiencies under ordinary working conditions, we towed a number of barges, first with one tug and then with the other, over the same reach of the river, indicating the engines at different speeds, and by means of a dynamometer obtaining the pull on the tow rope. The horsepower ascertained by the pull on the tow rope and the speed through the water would be less than the indicated power of the engines by the loss due to the propellers (whether paddle or screw), the friction in the machinery, and to the power absorbed in driving the tug itself. The barges towed were:

DETAILS OF BARGES USED IN TEST.

Barge.	Cargo.	Weight of Barge.
Severn	57 tons.	20 tons.
Royal Sovereign	50 "	15 "
Victory	50 "	15 "
Congo	Nil	20 "
Crane Boat No. 1	5 "	15 "
Total	162 tons.	85 tons.
Grand total		247 tons.

The comparative results are given in the following table, which shows the horsepower and speed in each case:

TOWING EXPERIMENTS WITH TUGS ROBIN HOOD AND LITTLE JOHN, WITH A VIEW TO TEST THE RELATIVE EFFICIENCY OF THE TWO SYSTEMS OF PROPULSION.

Name of Tug.	I. H. P. of Engines.	Pull on Tow Rope, Pounds.	Horse-power at Rope.	Percentage of Power of Machinery Utilized in Towing.	Speed (Miles) per Hour.
Robin Hood	90.2	2,314	31.6	35.0	5.12
	49.98	1,741	20.0	40.0	4.31
Little John	118.24	2,901	44.1	37.3	5.70
	94.37	2,321	32.3	34.2	5.22
	61.97	1,823	21.3	34.4	4.38

From these experiments and other data it was found that the proportion of the power of the engine utilized in towing is very nearly the same in both cases. The paddle boat is superior to the screw at low speeds and the screw better than the paddle at high speeds. On the average there does not appear to be any appreciable difference. It must, however, be borne in mind that one boat conforms to conditions of draft and dimensions which the other boat does not, the overall dimensions and draft of the *Little John* enabling her to pass through locks and over shallows which the *Robin Hood* could not.

In considering the question of towing on canals or shallow rivers, it is not unreasonable to assume that the screw working in a tunnel damages the banks to a minimum extent, and in this respect is better than the paddle or even a screw in its usual location; because, with the propeller working in a tunnel, the rush of water being in an inclined direction towards the bottom, rather tends to scour it and to keep open the course, while with paddles the effect would be rather to disturb the banks and to cause the earth that is washed away from the sides to settle in the middle.

NOTES ON SHALLOW-DRAFT STEAMERS.

BY A BRITISH SHIPBUILDER.

Only those who have been abroad and studied the question of shallow-draft rivers can realize the difficulty of transport and the obstacles which have to be overcome by those trading on these rivers and by the naval architects and shipbuilders who design and build shallow-draft vessels, i. e., boats drawing from 12 inches to 4 feet of water.

There are three systems of propulsion, namely, side paddle, stern wheel and screw in tunnel. The latter form of propulsion is the most up-to-date, and under certain conditions results have been obtained which are far superior to those of the side paddle or stern wheeler.

When a vessel is designed to carry cargo, her draft is constantly varying. For instance, a large vessel which G. Rennie & Company, Greenwich, has just constructed, at one time of the year draws 3 feet of water and at another time of the year can draw as much as 5 feet. It is here where the screw in tunnel vessel fitted with Messrs. Yarrow's ingenious hinged flap has a great pull over the side-paddle and stern-wheel type of vessel, for it is quite apparent that in either of these types of vessels the floats at one period would be too much immersed and at another period too little immersed to get the best results.

It must not be imagined, however, that all the advantages lay with the screw in tunnel boat. In going astern or in pulling up quickly undoubtedly the paddle wheel or stern wheeler has a considerable advantage. This, of course, is an objection to the screw vessel when trading on a river which is intersected with sand banks and narrow channels. It is here, we think, that the stern wheel has the advantage over the side

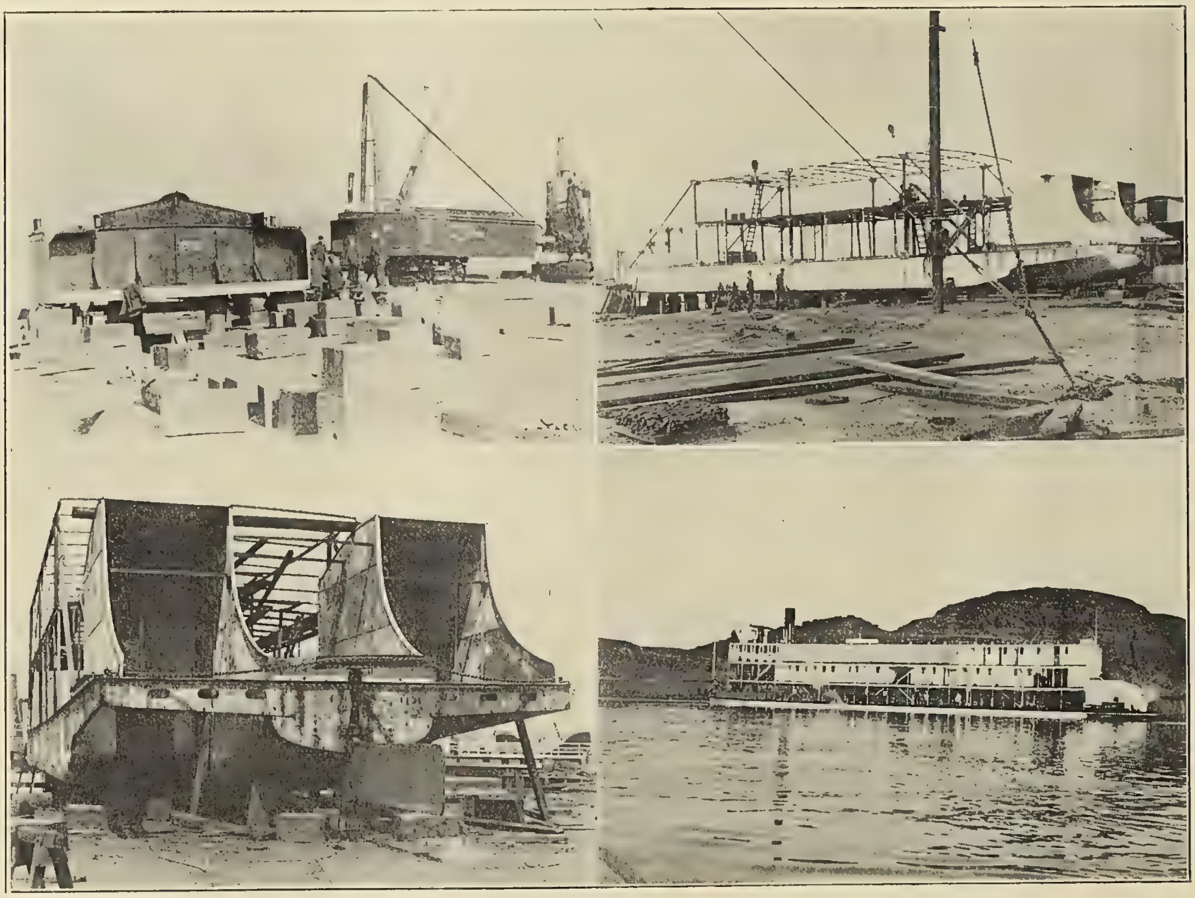


FIG. 1.—LARGE STEEL HULL, STERN-WHEEL RIVER STEAMER IN VARIOUS STAGES OF CONSTRUCTION.

LARGE BELGIAN RIVER STEAMER.

wheel, owing to less breadth which this type of vessel takes up in a narrow channel.

On rivers such as the Nile there is a great difference of opinion as to which form of propulsion is best. One large company will have nothing else but side-wheel vessels, and another company will have nothing to do with this class of boat and will insist upon having stern-wheel vessels. In general, when there is sufficient breadth of river, the side wheel seems to be preferable, and there is certainly not so much vibration from this form of propulsion.

Perhaps the greatest disadvantage of the stern-wheel steamer is derived from the fact that the engines and boiler must be at opposite ends of the vessel and thus necessitate the strengthening of the vessel by means of king posts and hogging girders in order to prevent any tendency for the vessel to buckle in the middle.

On the other hand the great advantage of the screw in tunnel over the side and stern-wheel steamer is the saving in weight of machinery. For instance in a vessel recently constructed by G. Rennie & Company there was a saving of 50 tons over the paddle boat of similar dimensions, and the power of the screw boat was nearly double that of the paddle. It will therefore he seen that when there is any question of carrying capacity on a given draft, there are great advantages to be derived from the screw in tunnel vessel.

Fig. 1 shows the sections of a shallow-draft, stern-wheel steamer being erected for shipment at the builders' yard. The view of the completed steamer shows one of the largest stern-wheel passenger steamers that have been built.

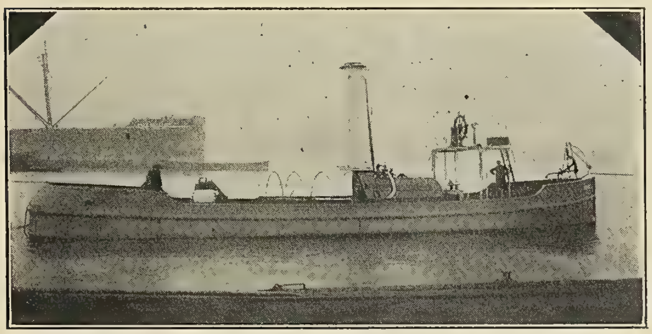


FIG. 2.

Fig. 2 shows a shallow-draft tug, built by G. Rennie & Company for towing purposes only. She is fitted with 200 horsepower engines and has a draft of 2 feet 10 inches aft and 18 inches forward, with 6 tons of coal on board. The speed is 10 knots and the screws work in partial tunnels.

Canada has reached tenth place among the nations in the world's shipping. At the end of the last fiscal year there were recorded in this country 7,768 vessels of 718,533 gross tons.

Belgian River Boats.

Many shallow draft river boats, both of the side-wheel and stern-wheel types, are built in Belgium by the Société Anonyme John Cockerill, Hoboken. While many of these are for service on Belgian rivers, yet large fleets have been built for navigating Russian rivers, including 54 for postal service and passenger and freight traffic on the Volga. Some of the boats in this fleet can accommodate 2,000 passengers and are fitted out with all the modern improvements which tend toward comfort and convenience of the passengers. One of the latest boats of this type is the Kriloff, 280 feet long, 1,000 indicated horsepower and a speed of five miles per hour, which is capable of carrying 19,000 pounds at the full load draft of 4 feet 8 inches.

The stern-wheel boats built by this company are destined largely for the Belgian colonies. Traffic on the Congo and its tributaries is carried out largely by boats of this type. The *Kintanbo* and *Segitini,* built for the Governor of the Belgian colonies, measure 164 feet long, 41 feet beam and 6½ feet depth. They carry 500 tons of cargo at a draft of 5 feet. Propulsion is by means of compound engines of 500 indicated horsepower, which gives them a speed of about 7 or 8 knots.

TOWING STEAMER FOR THE RIVER NILE.

James Rees & Sons Co., Pittsburg, Pa., have built for service on the Nile a shallow draft steamboat of the American Monongahela and Ohio river tow boat type. The principal dimensions are: Length, 141 feet; beam, molded, 26 feet; breadth over all, 26 feet 6 inches; depth of hold from the bottom of the floor to the top of the beam at the lowest place at the gunwale, 4 feet 6 inches. The sheer forward is 36 inches and aft 21 inches.

The hull is of steel with frames of angle bars 2½ by 3 inches by 6.5 pounds, spaced 18 inches apart. The deck beams under the forward deck are 6-inch channels, while the remainder are 2½ inches by 3 inches by 6.5-pound angles cambered 8 inches and spaced about 3 feet.

The hull is divided by three longitudinal bulkheads extending from the first athwartship bulkhead at the bow to the main transom. These bulkheads are of 6-pound plate stiffened by 2¼ inches by 2¼ inches by ¼-inch angles and are secured to the deck beams and deck by angle iron clip stringers from the forward bulkhead to the transom and to the keel and bottom plates by flanged intercostals, making an almost absolute watertight bulkhead. There are also five athwartship bulkheads built of 5.5-pound steel and stiffened with 2¼ inches by 2¼ inches by ¼-inch angles.

On each side of the center bulkhead is a keelson consisting of a 3-inch by 3-inch Z-bar extending from the forward bulkhead to the main transom. There is also one keelson at each bilge built of two Z-bars 4 inches by 6 inches by 15 pounds.

These are designed to support the upper deck stanchions and the main hog chain braces of the boat. There is one row of stanchions on each side of the center bulkhead of 2½ inches by 2½ inches by ¼-inch angles riveted to the deck beams and the Z-bar keelsons. They are spaced 6 feet between centers.

At the bow, where the shell plate is exposed to the severest wear, the plating is 5/16 inch thick. The first keel plate, including the garboards, are also 5/16 inch thick. The remainder of the plating is ¼ inch thick forward and on the knuckle and the balance is 3/16 inch. The sheer strake is 12 inches and 3/16 inch thick.

The deck under the boilers, in the coal bunkers and under the engine beams is of steel plate 3/16 inch thick. The rest of the deck is covered with 2¼-inch white pine, except the capstan bed, which is of steel covered with oak. The engine beams are of steel plate and angle bars of I-beam form. The main beam is 8 inches on the face and so arranged as to be securely riveted to the deck plate and beams and the main and after transoms and formed to receive the main pillow blocks, with steel castings forming the keying blocks and wheel chain brace steps.

There is one main hog chain on each side of the boat, and also one set of wheel chains with long fastenings in the hold forward. The hog chain braces are of gas pipe with cast iron top and foot pieces, except the wheel chain main king post, which is a steel casting.

The boat is steered by three balanced rudders with stocks of pipe and blades of steel supported and stiffened with angle iron. They are arranged to work in concave recesses, built in the stern of the boat and can swing to an angle of 43 degrees starboard or port. The rudders are operated by a steam steering gear, directly attached to the main tiller and controlled by levers in the pilot house. There is also an attachment for steering by hand when necessary.

The main engines are of the cross compound type with lever balanced poppet valves. The high-pressure cylinder is 16 inches diameter and the low-pressure 32 inches diameter, with a stroke of 6 feet. The valve motion on the full stroke rod is driven from a slide on the main connecting rod, and there is a variable cut-off on each engine adjustable while in motion from ⅜ths to full stroke. The motion for the cut-off is taken from the crosshead, thus giving all the cam motion of the engines from the inside, avoiding the danger of a cam attachment on the wheel shaft. The usual reversing arms and levers for operating the valve motion by steam are provided. The piston rods are of nickel steel with metallic packing. The crossheads are of cast steel with brasses adjustable with set screws. The slides are adjustable on cast iron bearings. The pillow blocks are all cast steel with the brasses properly fitted. The connecting rods are of white pine with iron straps welded to the forged pitman jaws with double king bolts in them.

The paddle wheel is 18 feet in diameter and 16 feet 6 inches wide. It is mounted on a shaft of refined new bar iron, 9 inches diameter of journal with 4 wheel centers of cast steel well keyed to the shaft. The wheel arms and circles are of iron and the floats of wood 30 inches wide.

The usual type of feed pump, known as the western river doctor, is fitted, consisting of two hot and two cold water pumps with a heater to heat the water as hot as possible from the exhaust steam of the pumps. There is also an auxiliary steam pump for washing decks, for fire purposes, etc. A hand deck pump is also provided for washing out the boilers by hand.

There are three boilers each 45 inches diameter, 18 feet long, with 44 tubes in each boiler designed for 175 pounds working pressure.

A surface condenser with brass tin tubes and brass heads, designed to take care of steam at a working pressure of 180 pounds and water at a temperature of 85 degrees, is installed with separate air and circulating pumps. A 17½ kilowatt generator with a double Sturtevant engine with switchboard is supplied for lighting the boat and operating a 4,000 candle-power searchlight.

The suction pipes in the hold are copper and brass and the balance of the steam and exhaust piping is of iron and steel. All the couplings and valves are of brass.

The deck machinery includes one large double cast iron barrel capstan with a large main spindle having a counter-shaft for double purchase with connection by shafts and wheels to the capstan engine with reversible valves and levers to operate the capstan by hand or by steam. There are also two hand capstans located alongside the boilers.

This boat was erected at the builders' works in Pittsburg, then taken apart and shipped to Egypt in packages not over 11 feet wide, 9 feet high or 28 feet long and not exceeding 10 tons in weight. The boat was then re-erected by the owners without any aid from the builders. Soon after she went into service trial trips were made, consisting of a preliminary run from Khartoum to Gebel Aoli and back, and a separate trial over a measured mile while towing three barges. The run from Khartoum to Gebel and back was made at a speed of 9⅓ miles per hour, and the engineer under whose supervision the test was run stated that the main engines worked well, giving plenty of power and proving simple to handle and reverse. During the run the boiler pressure ranged from 140 to 150 pounds. The condenser and feed water heater worked satisfactorily and a vacuum varying between 22.5 and 25 inches was attained. No trouble was experienced in operating the doctor feed pump. It was found that the draft of the boat exceeded 3 feet, with less than 10 tons of coal on board, by about 4 to 6 inches.

On the speed trials over the measured mile, towing three barges, the starboard barge was loaded with stone and drew 4 feet 6 inches; the port barge was loaded with coal and drew 4 feet ½ inch, and the head barge was loaded with stone and drew 4 feet 6½ inches, the average draft of the three being 4 feet ⅓ inch, representing a load of about 817 tons, irrespective of the actual weight of the barges.

On the first trial, the boat made a speed upstream of 5.397 miles per hour and downstream of 7.25 miles per hour, giving a mean speed of 6.313 miles per hour. On a second trial the speed upstream was 5.81 miles per hour and downstream 7.42 miles per hour, giving a mean of 6.615 miles per hour. The steam pressure on these trials did not drop below 155 and was usually between 165 and 170. No coal consumption records were kept on these trials, because results obtained on such short trials are apt to be misleading, but from the statistics of the coal consumption on regular trips to Malakal, the owners state that the boat is very satisfactory on the score of fuel economy. The speed trials showed that a faster craft was built than was anticipated and there proved to be plenty of power to meet all needs.

The Bureau of Navigation reports 376 sail and steam vessels of 95,137 gross tons built in the United States and officially numbered during the quarter ended Sept. 30, 1910. During the corresponding quarter ended Sept. 30, 1909, 347 sail and steam vessels of 48,914 gross tons were built in the United States and officially numbered. There is, therefore, an improvement of nearly 49 percent in this year's showing, as compared with that of last year. Forty-five percent of the total tonnage was comprised of steel steamers built on the Atlantic and Gulf coasts, and 39 percent were steel steamers built on the Great Lakes.

LARGE SIDE-WHEEL PASSENGER STEAMER ON THE RIVER NILE.

The Nile Passenger Steamer Egypt.

Many shallow-draft steamers have been placed in service on the River Nile, but probably the most luxurious is the side-paddle passenger steamer *Egypt,* which was built for Messrs. Thomas Cook & Sons, Ltd., by John I. Thornycroft & Company, Ltd., Southampton. The illustrations show the steamer under service conditions, manned by a native crew, on the River Nile. The interior views give a good idea of the spacious and sumptuous nature of her accommodations. The boat is 230 feet long over all, with a beam of 32 feet. Her depth is 9 feet 6 inches, and the actual draft, fully loaded, only 3 feet 3 inches. She was shipped from the builders' works in loose plates and angles and re-erected at Cairo. The engines are of the diagonal tri-compound, surface-condensing type, capable of giving the boat a speed of over 10 miles per hour.

Shallow-Draft Stern-Wheeler for Mexico.

The Johnson Iron Works, Ltd., New Orleans, La., has under construction a steel-hull stern-wheel steamer, 87 feet between perpendiculars, 24 feet beam, with 4 feet depth of hold amidships. The hull is constructed of galvanized steel plates and has a center line plate and two truss bulkheads. There are also four athwartship bulkheads and steel deck beams, with a yellow pine deck inside the stringer plates. The cabin is to be fitted up for the accommodation of twenty passengers, and will be constructed of mahogany and Spanish cedar. The

INTERIOR VIEWS ON BOARD THE EGYPT.

machinery equipment consists of a pair of tandem compound engines, 7½ inches by 15 inches by 36 inches stroke, fitted with a surface condenser. Steam is supplied by boilers of the firebox return-tubular type, equipped with two feed pumps. The boat will draw 22 inches of water with 30 tons of freight on board.

The Corona.

Recently the Crown Agents for the Colonies for Northern Nigeria ordered a twin-screw, shallow-draft steamer from Messrs. Forrestt & Company, Ltd., Wyvenhoe, for use as the High Commissioner's yacht. The hull is 160 feet by 30 feet by 5 feet 6 inches, and with stores and a cargo of 38 tons on board it has a draft of 24 inches. The speed is 10½ miles per hour. Comfortable quarters for the High Commissioner are located on the upper deck forward, consisting of a spacious dining room furnished in American oak, adjoining which are the High Commissioner's office and two large sleeping apartments. Accommodation is also provided for the several officers, captain, European engineers and native crew.

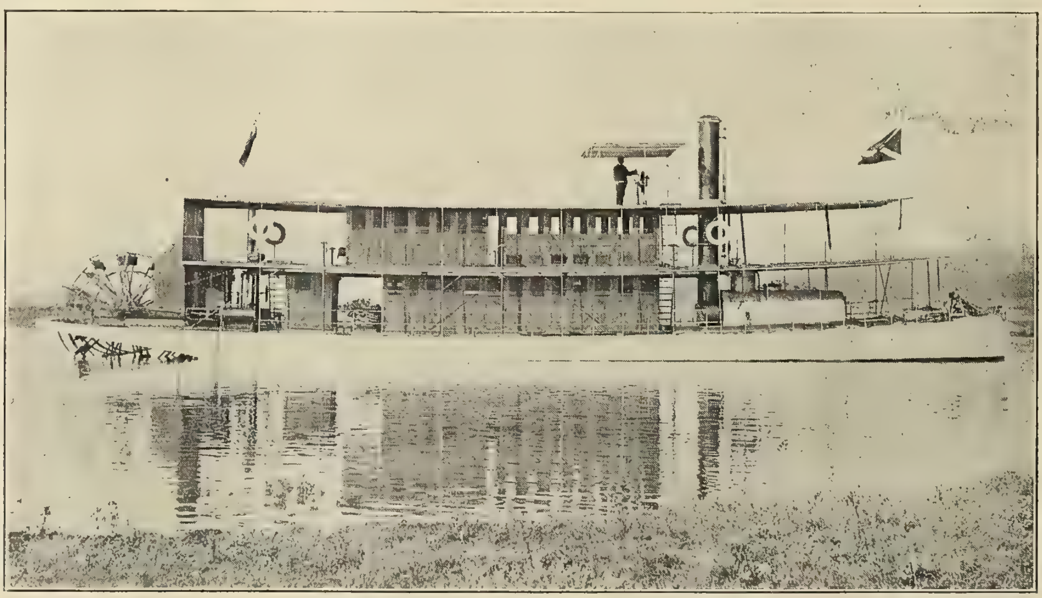
The propelling machinery is of the triple-expansion type, with two watertube Stirling boilers. The designed horsepower is 300. There are also a steam-steering gear, electric light outfit, hot and cold-water baths, refrigerating chamber and plant, and a powerful searchlight.

THE CORONA.

The Millepede.

In the construction of the *Millepede*, a photograph of which is shown herewith, the absence of heavy hog chains and braces should be noted. This, coupled with the comparatively light paddle wheel, marks the principal distinction between many British and American-built stern-wheel river boats. The *Millepede* was built by Forrestt & Company, Ltd., Wyvenhoe, for service on the Zambesi. The hull is 99 feet long by 16 feet broad by 4 feet deep, with a draft of 18 inches. Steam is furnished by a locomotive boiler and propulsion is by means of high-pressure engines aggregating 145 horsepower, giving the boat a speed of 11 miles per hour. The hull is of galvanized steel, built in sections for shipment and the passenger accommodations are in teak deckhouses on the main and upper decks.

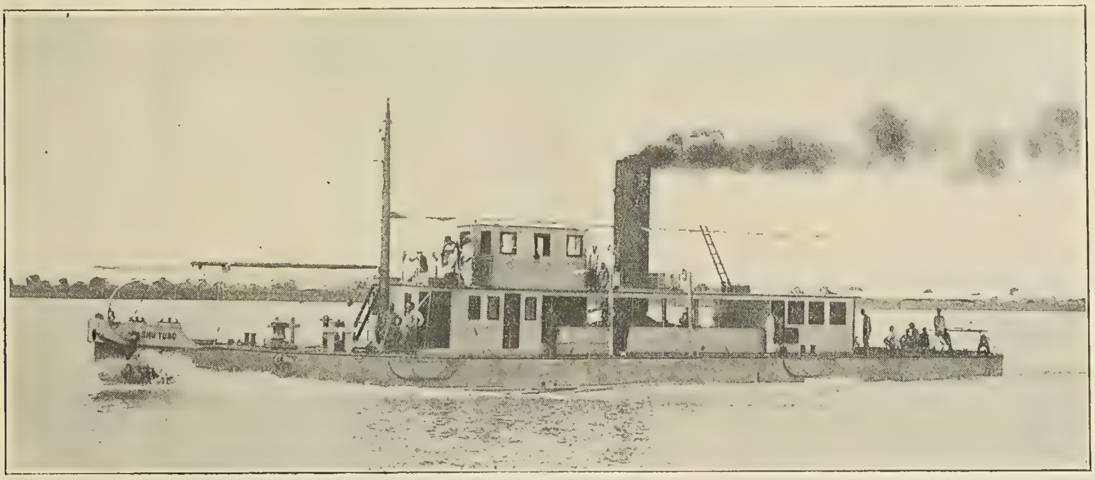
Messrs. Vickers, Sons & Maxim are to build an experimental model towing tank at their works at Barrow-in-Furness.



THE MILLEPEDE.

The Tow Boat Schutung.

The beginning of the development of interior waterways in China has called for shallow-draft passenger and tow boats which are capable of navigating swift rapids, particularly on the upper Yangtse Kiang. This river has been navigated for many years as far as Ichang, which is a thousand miles from the sea, by vessels of 2,000 tons, but until recently navigation beyond Ichang has been entirely carried on by junks, which have taken from four to five weeks for the passage to Chungking, owing to numerous rapids in the river. The navigation of this part of the river by steam was first shown to be feasible by the successful voyages of a number of British gunboats constructed by Messrs. Thornycroft. Recently, however, there has been inaugurated a regular steamboat service by the Szechuan Steam Navigation Company. For this service the steamer *Schutung* has been built by Messrs. John I. Thornycroft & Company, Ltd., Southampton, from designs by and under the supervision of Captain Plant, marine superintendent of the company. At the same time there was constructed a flat, to be towed by the *Schutung*. Both vessels were built in sections and shipped to the East, where they were erected at the Kiangnan Arsenal Dockyard.



TWIN-SCREW TUNNEL TOW-BOAT SCHUTUNG, DESIGNED FOR SERVICE ON THE YANGTSE KIANG RIVER, CHINA.

The *Schutung* is 150 feet long, 15 feet beam, with a depth of 6 feet 6 inches. The propelling machinery consists of two sets of Thornycroft compound surface-condensing engines, aggregating 550 indicated horsepower, which drive twin screws working in tunnels. The speed of the boat on trial was 12 2/3 miles per hour. The flat, which is towed by the steamer, is of the same length and type, but the beam is 16 feet.

Although some of the rapids through which this boat has to operate are exceptionally swift and turbulent, the current in some places amounting to 12 knots and varying greatly with the season of the year, yet under easy current conditions the *Schutung* was able to make the entire journey up the river without resorting to the use of tackle, hawsers, etc., to pull her through the rapids. At the worst point it was necessary to let the boat drift backwards, so that the fires could be cleaned, and then, by careful management in the stoke-hold, full steam pressure was maintained on the engines and the boat successfully negotiated the rapids in spite of the tendency of the propellers to race in the violent swirls of water.

A 100-Foot River Boat.

A 100-foot steel-hull passenger and freight steamer is being constructed by the Dubuque Boat & Boiler Works, Dubuque, Iowa, for service in a river where the depth of water is limited at certain times of the year to 12 inches. The hull is 100 feet 6 inches long, 28 feet wide, with an 8-foot depth of hold. The shell plating is 3/16 inch thick, and the frames are 2 inches by 3 inches by 3/16-inch angle bars. There is one center line plate bulkhead and four additional longitudinal trusses. The main deck beams are channel, 3 inches by 4 inches, and the deck is plated with 8-pound steel.

The machinery plant consists of one tubular boiler, 40 inches in diameter and 10 feet long, with an 18-inch by 18-inch dome. It contains seventy-one 2-inch tubes and is designed for a working pressure of 200 pounds per square inch. The grate area is 12 square feet. There is one pair of 8-inch by 48-inch poppet valve high-pressure engines, with California cut-off. The auxiliaries include a Dubuque boiler feed doctor; a 4-inch by 6-inch type-B Providence capstan, built by the American Ship Windlass Company, Providence, R. I.; and a Carlisle & Finch electric lighting outfit, supplying power for seventy-five incandescent lamps and one 2,000 candle power, 10 ampere searchlight.

Twin-Screw, Shallow-Draft Tug Brinji.

Edward Hayes, of Stony Stratford, has recently built a 60-foot twin-screw tug, for service on the Euphrates River. The boat has a beam of 11 feet and a draft of 3 feet. The engines are each 6 inches by 12 inches by 8 inches stroke, and exhaust into one of the builder's special light-weight condensing plants, which is driven by a small compound surface-condensing engine, 3½ inches by 7 inches by 5 inches. The boilers are of the marine return-tube type, built under Lloyd's Survey for 120 pounds working pressure. The builders have found this pressure to be the best for these vessels, as they are nearly always operated by natives and it is necessary to have all machinery as simple as possible on this account. The designed speed is 12 miles per hour.

A Model German Towing Steamer.

Many types of tugs, steamers, and barges are in use in the vast Elbe River traffic, progress having been made steadily in the direction of larger, higher-powered craft.

Of late much favorable attention has been directed to the tug *Kaiser Wilhelm II*, as the largest and apparently most successful vessel thus far utilized in the business, and a close description of this steamer has been requested by one of the American commissions interested in the development of internal navigation in the United States.

The vessel in question was ordered in 1902 by the Oesterreichische Nordwestdampfschiffahrts-Gesellschaft, whose managers were convinced that tugs of the largest dimensions possible on the Elbe, both as respects size and power, could be operated with the greatest relative economy. The results seem to have exceeded original expectations. The *Kaiser Wilhelm II* is now operated by the Vereinigte Elbe-Schiffahrtsgesellschaften Aktien-Gesellschaft, of Dresden, to which company all ships of the Austrian line have been leased under a special agreement. The vessel plies exclusively between Hamburg and Magdeburg, on the Elbe. It was constructed by the Dresdner Maschinenfabrik und Schiffswerft Uebigau Aktien-Gesellschaft, one of the largest shipyards for river craft in Germany.

The principal measurements of the vessel are as follows:

Length between perpendiculars	236.2 feet
Beam at midship section	29.5 "
Beam over paddle boxes	60.7 "
Depth at sides	9.4 "
Draft in use, with 20 tons coal	3.2 "

The contract required that when the vessel was loaded to 50 percent of its carrying capacity, and with 900 indicated horsepower, it should have a towing power of 4.500 tons, distributed in ten or eleven iron barges, with a stage of water in the river of between 5.2 feet and 6.6 feet, according to the Magdeburg gage. The test run from the railroad bridge at Wittenberg to the Herrenkrug Bridge at Magdeburg (upstream) was to be made in thirty-three to thirty-five hours, and the consumption of coal of good quality of 7,500 calories was not to exceed 2 pounds per indicated horsepower per hour. These conditions were easily fulfilled. During the trial trip the vessel towed eight barges of a cargo of 4,517.7 metric tons of all kinds of merchandise. The trip was made in thirty-one hours instead of thirty-three hours, the average indicated capacity being 950 horsepower, at 39 revolutions per minute. The consumption of coal amounted to 1¾ pounds per indicated horsepower an hour, including steam consumption of the steering engine. The heating power of the coal measured calometrically was 7,730 calories.

Since the ship was put in commission, in 1903, it has been in constant use, except at times when navigation on the Elbe was interrupted by ice or for other reasons. Instead of 4,500 tons, the vessel is almost regularly towing 6,000 tons. In 1905 the vessel was employed 259 days, during which period 10,600 miles were traversed, the towing amounting to 26,650,000 ton miles, in 514 barges.—*Daily Consular and Trade Reports.*

Naval Architects' Meeting.

The eighteenth general meeting of the Society of Naval Architects and Marine Engineers will be held in Assembly Room No. 1, Engineering Societies' Building, 29 West Thirty-ninth Street, New York, Thursday and Friday, November 17 and 18, and will begin at 10 a. m. each day. The society's rooms will be open for the use of all members and the usual conveniences provided.

There will be a banquet in the Waldorf-Astoria (Astor Gallery) at 7 P. M. Friday, November 18, to which all members and their guests are cordially invited. Tickets are $5 each and seats can be engaged in advance or at the meeting.

The council will meet at 3 P. M. Wednesday, November 16. Proposals for membership should be mailed so as to reach the secretary on or before November 16.

The following is a list of the papers expected to be read during the meeting:

Notes on the Armaments of Ships, by Sir William White, honorary member.

Evolution of Screw Propulsion, Part II., by Mr. Charles H. Cramp, vice-president.

The History and Economic Value of Canals, with Special Reference to the Cape Cod Canal, by Mr. Jacob W. Miller, vice-president.

Experiments on the *Fronde*, by Professor C. H. Peabody, member of council.

Comparative Results in Steam and Coal Consumption, with Turbines, Reciprocating Engines and a Combination of the Two on the Steam Yacht *Vanadis*, by Mr. Clinton H. Crane, member.

Progressive Speed Trials of the U. S. S. *Gresham*, by Professor W. S. Leland, member.

Floating Dry Docks in the United States—Relative Value of Wood and Steel for their Construction, by Mr. William T. Donnelly, member.

New Propelling Machinery for the S. S. *Creole*, by Mr. John F. Metten, member.

The Gyroscope for Marine Purposes, by Mr. Elmer A. Sperry, member.

An Analysis of Tests of Watertight Bulkheads, with Practical Rules and Tables for their Construction, by Professor Wm. Hovgaard, member.

Preventing Fires on Shipboard, by Mr. Samuel D. McComb, member.

The Possibility of the Internal Combustion Engine in the Marine Field, by Mr. Theodore Lucas, member.

Coaling at Sea Experiments, by Mr. Spencer Miller, member.

Marine Producer Gas Engines, by Mr. Charles B. Page, member.

Our Constitutional Shipping Policy and the Compact for its Establishment, by Mr. William W. Bates, member.

INSTALLATION OF A DIESEL MARINE ENGINE ON A LAKE STEAMER.

A case has recently come to our attention where it was found necessary to increase the speed of a certain passenger steamer in order to maintain a profitable service. The steam plant on the boat was not of a modern type, and undoubtedly the performance of the boat could have been improved by substituting a thoroughly modern steam plant. At the same time, however, so much additional power was needed that it was doubtful if a steam plant of the requisite size could have been installed without increasing the draft of the boat and, therefore, increasing its resistance in proportion. The problem was solved by installing a Diesel marine engine of the type built by Sulzer Bros., Winterthur, Switzerland.

The old steam plant was of about 70 indicated horsepower, and its total weight, including boiler, water, smokestack, uptakes, fuel for a 75-mile trip, engine and piping, was 32,400 pounds. The speed of the boat was only about 7½ knots. The Diesel engine installed was of 150 horsepower, and weighed, together with all auxiliaries, fuel tanks and sufficient fuel for a 750-mile trip, 21,500 pounds. Therefore the substitution of the Diesel engine plant showed a saving in weight of approximately 5 tons, which resulted in a noticeable decrease in the draft of the vessel with a consequent considerable diminution of the resistance of the boat in the water. This, in turn, resulted in higher speed for the same output of power. Compared with the former steam plant, the efficiency has been doubled, the supply of liquid fuel carried is sufficient to enable the vessel to travel ten times the distance previously possible, and this at a speed of 11 knots instead of 7½ knots, while a saving in weight of 35 percent has been effected.

The construction of the motor is shown in Fig. 1, while the installation in the steamship is shown in Fig. 2. A complete

description of this type of motor was published in our January, 1910, issue. It will be recalled that the engine has four working cylinders of the single-acting, two-stroke type, besides an air pump for the highly compressed air used for starting, reversing and the injection of the fuel, and also a low-pressure air pump for scavenging the cylinders.

TRIAL RUN	No. 1.	No. 2.	No. 3.
Speed, knots	10.6	10.9	10.1
Distance covered, miles	14.9	14.9	6.1
Time, minutes	73.	71.27	31.6
Fuel consumption, pounds	83.7	92.3	23
Fuel consumption per mile	5.617	6.194	3.77
Revolutions of screw per minute	300	310.9	259
Power of engine, I. H. P.	174	192	114
Fuel consumption per I. H. P.-hour, lbs.	0.395	0.404	0.383
Cost of fuel per mile, pence	1.5	1.67	1.01

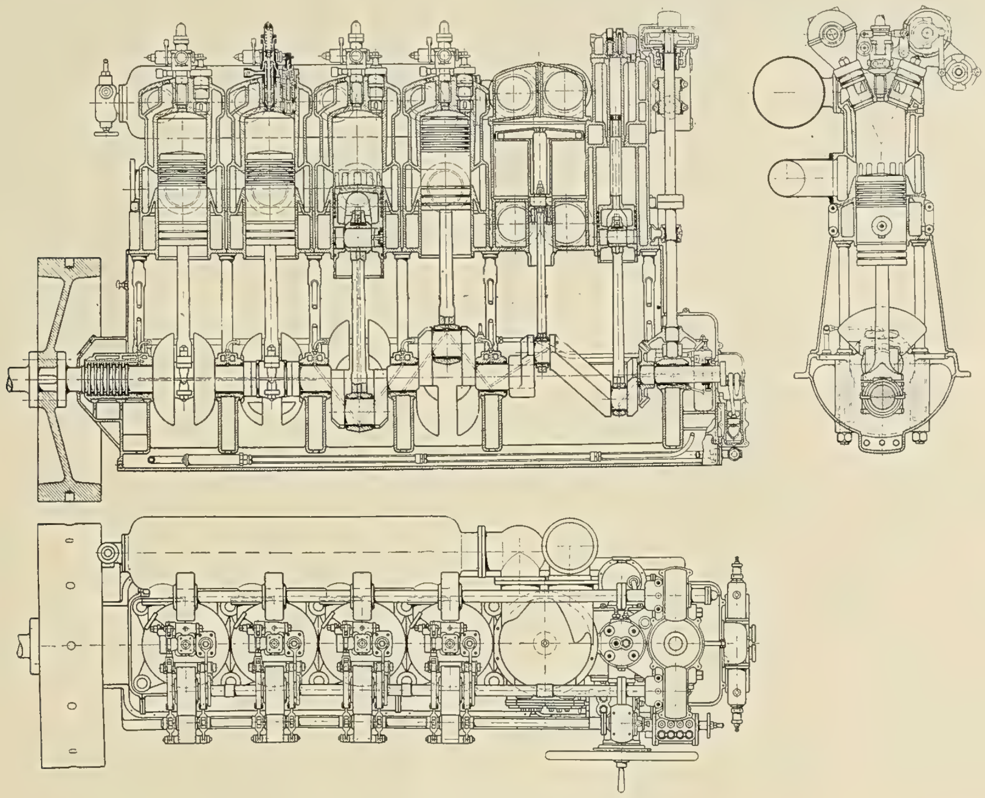


FIG. 1.—SULZER MARINE DIESEL ENGINE.

The trial runs with this vessel, which were carried out by the Zurich Steamship Company, took place on Sept. 30, 1909. The course covered in runs 1 and 2 was exactly 14.9 miles, while course No. 3 measured 6.1 miles. The price of fuel was estimated at about 48s. ($11.50) per ton. Formerly, when steam was used on this boat, the coal consumption, including heating

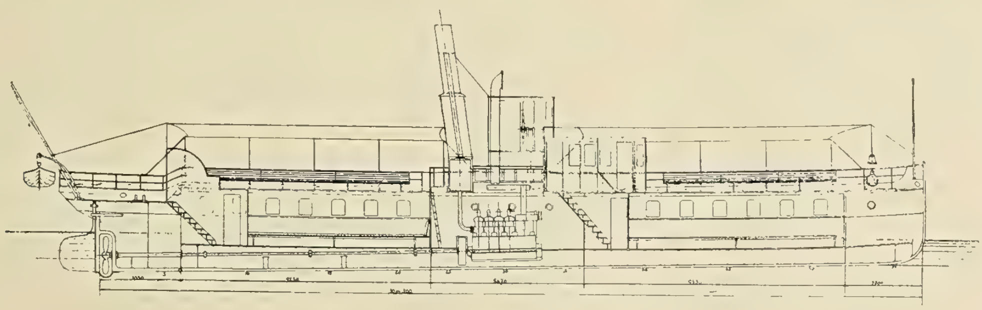


FIG. 2.

up, was 30 pounds per mile, corresponding to approximately 2¾d. at a speed of 7½ knots. The cost of fuel now amounts to only one-fourth of that required when the boat was propelled by steam, while the speed is increased by 35 percent. Running expenses have also been materially reduced since cleaning, repairs and engine room staff have all been reduced to a minimum. The results of the tests were as follows:

Ruling of the Office of the Supervising Inspector-General of the United States Steamboat Inspection Service.

The matter of the authority of local inspectors to specify the distance that must exist between the back and ends of boilers and the bulkheads on towing steamers having been under consideration, it may be stated that the last paragraph of section 29, Rule II, General Rules and Regulations, provides that "*All* boilers shall have a clear space at back and ends. When located in close proximity to wooden bulkheads the space between boiler or boilers and bulkheads shall be not less than two feet; with iron or steel bulkheads, not less than 16 inches."

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertising, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following. If proof is to be submitted, copy must be in our hands not later than the 10th of the month.

Notice to Readers.

In order to present in this issue a complete discussion of shallow-draft river boats, all serial articles as well as the letters from practical engineers have been omitted. The next installment of all continued articles will appear in our December issue.

Shallow-Draft River Boats.

No hard and fast rules can be laid down regarding the design of shallow-draft river boats. The conditions of navigation vary on different rivers and generally a different type of boat is needed to navigate the upper waters of a large river than would be needed on the lower part of the river, where the depth of water is greater and the channel freer. In many navigable rivers there are rapids where the current reaches a speed of 12 miles an hour and over, while in others the water carries so much mud and silt in suspension that old channels are frequently choked up, new bars formed and the regular channel changes its position in an incredibly short time. It is evident that all these various characteristics in the rivers themselves will have some influence on the type of boat to be used and the kind of propulsion which must be adopted to give the most efficient service.

In qualifying the subject of this article by the title Shallow Draft River Steamers, it is intended to confine the discussion to boats operating on rivers where the depth of water does not exceed nine feet and where the draft of the boat may be anything from one to five or six feet. The river steamers operating at tide water on large rivers are not influenced by the same considerations which govern the shallower draft boats which navigate to the head waters of the rivers, and their design presents a very different problem. Confining ourselves, therefore, to the lightest draft vessels, it is noticeable at once that the design of the hull is very similar in a majority of cases. Bluff bows, wide sterns, flat bottoms and vertical sides are the main characteristics of the hulls for shallow draft river boats. The draft is usually greater at the bow than at the stern and, if propulsion is by means of a stern wheel or propellers, the boat is usually designed to maintain a constant draft at the stern to insure constant immersion of either the paddles or propellers, the loading of the boat simply changing the trim and bringing the hull down by the head. By allowing greater draft at the bow than at the stern the boats are found to steer much easier, and in case of grounding only the bow is affected and the vessel can usually be worked off by her own power, or if it is desired to lift her over a narrow bar a form of shears can be employed to force the bow across the bar, and this operation will usually make a sufficient channel so that the remainder of the hull will readily pass over the obstruction. The most important reason for making a hull pivotal about the stern, however, is in order to insure constant immersion of the paddle wheel or propellers, as the case may be. As the hulls are both broad and shallow the principal weights are distributed as widely as possible, and the entire hull is thoroughly braced by systems of hog chains, which supply the lack of structural strength in the hull itself. Steel is now almost universally taking the place of wood as material for hull construction and it is greatly superior for use in tropical waters, where wood quickly deteriorates. Where the bottom plates are made of steel at least 1/8 inch thick, or six pounds to the foot, with composite construction the hull will usually outwear and outlast the best wood hull that could be built.

Propulsion of river steamers may be by one of three methods—the stern-wheel paddle, the side-wheel paddle, or the screw propeller. The means of propulsion to be adopted in any case depends almost entirely upon the nature of the river on which the boat is to operate. All three systems are in successful use, but the stern-wheel boat is at present the predominating type. The stern wheeler is used in preference to the side wheeler because the principal weights in such a boat are so disposed that for equal strength of hull the weight of the material in the stern-wheel boat can be less than in a side-wheel boat of corresponding size. Furthermore, the stern wheeler permits a less overall width, and this

is frequently a factor of considerable importance where the width of channel is limited. The use of screw propellers was not very general until the tunnel form of construction was invented and perfected, so that the screws could be protected from damage in case of grounding or of striking floating timber or rocks. Some of the earlier screw-propelled river boats, unfortunately, were not very successful, and this has caused some prejudice in the minds of the older river men against this type of propulsion. There are so many advantages to be gained by its use, however, that it would seem that future developments in shallow-draft river steamers must lie very largely in this direction. Substituting screw propellers for stern-paddle wheels permits an enormous reduction in the weight of the propellers and shafting; the weight of the engines can also be greatly reduced; and, by using a modern type of compound or triple-expansion engine, the economy of steam consumption can be improved vastly over the performance of the ordinary lever poppet valve type of stern-wheel engine, while by the use of watertube boilers the machinery weights can be still further reduced. The machinery space also can be largely reduced by the use of screw propellers. According to one well-known builder of river steamers, a stern wheeler is a trifle superior to a side wheeler from the point of propelling efficiency, since the wheel is working in or near the top of the wave, which follows very close to the stern of the hull, and this claim is frequently justified in the navigation of rapids, where river boats are put to their hardest test.

Although it is almost impossible to secure reliable data regarding the performance of stern-wheel steam boats of the type used on the Western rivers of the United States, yet they are usually considered to be very wasteful of steam. As a rule the boiler plant is fairly efficient, considering the quality of water which must be handled in the majority of cases, but forcing is resorted to to such an extent that an excessive amount of steam is frequently used by means of jet blowers in the flues for increasing the draft. Where exhaust steam from the engines is used for this purpose the loss is not so noticeable. The performance of the engines, about which so much speculation seems to exist, is undoubtedly poor as compared to modern marine engines used elsewhere. Where simple non-condensing engines are used, high-pressure steam is employed and the exhaust is frequently at high pressure, most of the energy in the exhaust steam being thrown away except what is gained from heating the feed water and increasing the draft in the boilers. Compound condensing engines for stern-wheel boats, while more economical, are not generally favored by river men, since the added weight and complication are serious disadvantages. They are useful principally in large boats.

Improvements in existing types of river craft will undoubtedly be in the direction of increasing the efficiency of the steam plant; increasing the maneuvering power of the boats themselves, and providing more economical means of handling and carrying freight. Increased economy in the steam plant, although perhaps not increased propulsive efficiency, can be gained by the adoption of screw propulsion, which will admit of the use of the most economical type of marine engines and watertube boilers. In the case of stern-wheel steamers, the use of two independent light steel feathering paddle wheels, driven by compound engines of modern design, will undoubtedly be effective in packet steamers, but for tow boats, particularly those of the type used on the Western rivers of America, where the boat is used principally as a rudder for immense fleets of coal barges, aggregating anywhere from twenty to sixty thousand tons in a single tow, it is doubtful if any better form of propulsion can be devised than the old-fashioned, large, heavy stern wheel with wooden buckets, which has proved so effective for this work. In boats where screw propulsion can be adopted, a further increase in efficiency is possible through the use of internal combustion engines, operating on either heavy oil or producer gas. The maneuvering properties of stern-wheel boats can be improved by adopting two independent wheels and by the use of monkey rudders aft of the wheels, as well as the usual rudders forward of the wheel. Improvements in the carrying capacity and means for handling freight on board river boats are already being developed by the construction of steel barges suitable for different classes of freight and the installation of mechanical appliances at terminals for handling the freight.

Terminal Facilities at River Ports.

Adequate terminal facilities at river ports are quite as important for the development of river steamboat traffic as are modern types of carriers or river and harbor improvements. In the report of the United States Commissioner of Corporations on transportation by water in the United States, it is stated that the harbors of the country, as a rule, have by no means developed their frontage to the full capacity, nor have they organized and co-ordinated to the best advantage their commercial and industrial functions. It is further stated that great influence is exercised by railroads over water terminals either through ownership, through indirect control, or through long-term leases of water-front property, and that there is very little effective linking up of the rail and water transportation systems, but, on the contrary, the tendency seems toward division and adverse action, to the great detriment of the transportation needs of the public. Finally, there is a striking lack of co-operation with the Federal Government on the part of localities benefiting by channel improvement. These are conditions which must be given immediate attention if transportation by inland rivers is to be developed to the fullest extent of its possibilities.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		Sept. 1.	Oct. 1.
Florida	20,000	20¾	Navy Yard, New York......	74.2	77.4
Utah	20,000	20¾	New York Shipbuilding Co...	85.5	88.0
Arkansas ...	26,000	20½	New York Shipbuilding Co...	43.9	47.8
Wyoming ..	26,000	20½	Wm. Cramp & Sons.........	35.5	38.9

TORPEDO-BOAT DESTROYERS.

Paulding ...	742	29½	Bath Iron Works..........	98.9	100.0
Drayton	742	29½	Bath Iron Works...........	91.7	94.4
Roe	742	29½	Newp't News Shipbuilding Co.	99.3	100.0
Terry	742	29½	Newp't News Shipbuilding Co.	93.5	99.0
Perkins	742	29½	Fore River Shipbuilding Co...	93.8	97.4
Sterrett	742	29½	Fore River Shipbuilding Co...	89.8	90.8
McCall	742	29½	New York Shipbuilding Co...	95.5	95.9
Burrows	742	29½	New York Shipbuilding Co...	92.7	94.9
Warrington..	742	29½	Wm. Cramp & Sons.........	81.4	84.7
Mayrant	742	29½	Wm. Cramp & Sons.........	82.0	83.7
Monaghan ..	742	29½	Newp't News Shipbuilding Co.	31.3	35.6
Trippe	742	29½	Bath Iron Works...........	62.6	68.3
Walke	742	29½	Fore River Shipbuilding Co...	52.8	57.5
Ammen	742	29½	New York Shipbuilding Co...	65.4	72.4
Patterson ...	742	29½	Wm. Cramp & Sons.........	44.6	47.8

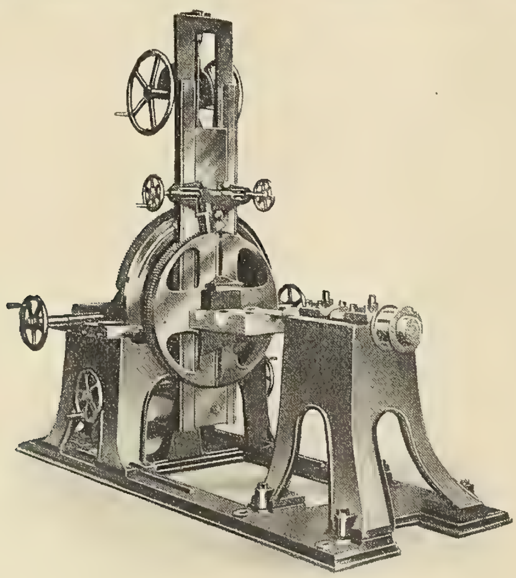
SUBMARINE TORPEDO BOATS.

Salmon	...	..	Fore River Shipbuilding Co...	98.4	100.0
Seal	...	..	Newp't News Shipbuilding Co.	54.4	55.9
Carp	...	..	Union Iron Works..........	62.0	63.0
Barracuda ..	...	..	Union Iron Works..........	62.7	64.8
Pickerel	...	..	The Moran Co..............	58.1	61.1
Skate	...	..	The Moran Co..............	58.1	61.1
Skipjack	...	..	Fore River Shipbuilding Co...	54.0	56.3
Sturgeon ...	...	..	Fore River Shipbuilding Co...	52.5	55.4
Tuna	...	..	Newp't News Shipbuilding Co.	31.8	32.4
Thrasher ...	...	..	Wm. Cramp & Sons.........	10.8	15.7

ENGINEERING SPECIALTIES.

Allan's Patent Comprehensive Woodworker.

Among the newer designs of woodworking machinery that have been introduced in recent years there is an important class constructed chiefly to deal with the difficulties of pattern-making, and for the cutting out of core boxes. As every engineer knows, core boxes are of endless variety, and so



variable that they cannot be touched by ordinary machinery. Designers and inventors have therefore been working out new ideas, with the object of introducing machinery with such flexibility of movement that it could be adapted to deal with all the intricacies and variations that are met with in the pattern shop.

What is claimed to be the simplest and most powerful of these machines is the Patent Comprehensive Woodworker, designed and supplied by R. S. Allan & Company, Gateshead-on-Tyne. This machine, as can be seen from the illustration, has two principal parts mounted on a common foundation or bed-plate. The first important part is the pedestal, bolted to one end of the bed-plate, and which carries a powerful horizontal spindle, which is driven by the pulley on the outer end. The spindle runs in adjustable cone bearings, which, it is claimed, provide absolute steadiness and freedom from vibration. The inner end of the spindle is fitted with suitable arrangement for fixing the cutting tools. Facing the cutters, and raised on V-guides formed on the bed-plate, is a large, powerful stand of simple construction, but with wonderful diversity of movement, which forms the work-carrier. The base is formed with four feet, which rest on the V-guides, and is controlled by a screw and hand-wheel, so that the whole stand can be adjusted to or from the cutters to accommodate large or small work. Mounted on this is a compound slide, by which the work can be advanced to the cutting tools and the depth of cut controlled. This is regulated by the lowest set of hand-wheels on each side of the base.

Mounted on the compound slide is a table formed on the edge, with a quadrant at right angles to the table and with a vertical face towards the spindle. The flange of the quadrant has a set of teeth cut thereon. A long, rectangular member, which carries an adjustable slide, is pivoted on the face of the quadrant, having fixed at the back a bracket with worm and gear, which engages the teeth on the flange and enables the guide or member to be set over at pleasure, either to the right or left of the perpendicular, through an arc of about 60 percent either way, so that work can be readily set at any desired angle by the markings which are cut on the face of the quadrant.

To the slide in this member is bolted a circular work-table or turret, at the edge of which a set of teeth is cut. A worm gear and hand-wheels are carried on the face of the slide above the table, and the worm engages the teeth and so enables the table to be revolved in either direction at will.

All the movements are well arranged and independent, and do not interfere with the setting or working of the machine whatever the position may be, and the machine can be used for all kinds of grooving, half-lapping, trenching, slotting, etc., and for panel moulding, moulding, ships' gratings, ladders and a great variety of general work. Machines of this type are at present being exhibited by the builders at the Brussels International Exhibition, the Japan-British Exhibition, and next month they will be exhibited at the Manchester Engineering and Machinery Exhibition.

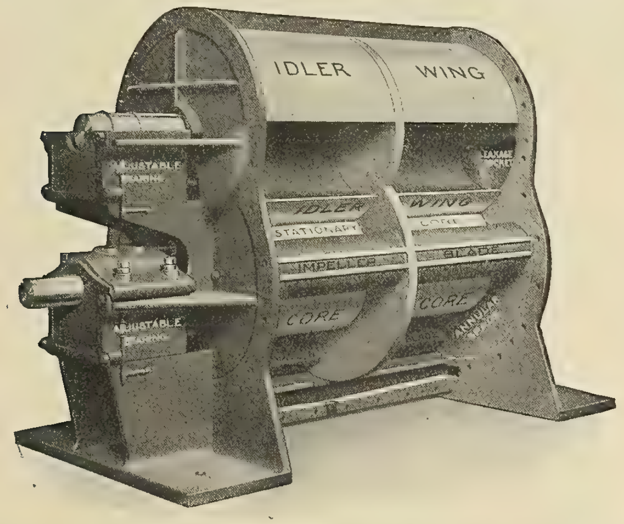
Blower for Fuel Oil Burning.

The high-pressure blower described in this article is being successfully used in marine work for furnishing blast in connection with fuel oil burning, both on shipboard and in navy yards. It is one of the products of the B. F. Sturtevant Company, of Hyde Park, Mass., who claim for it several distinctive features both in design and construction. Although this blower is of the positive type, by its design and operation it is claimed to overcome almost entirely strong pulsations in the discharge and internal contact of the rotors, resulting in a tendency to wear out and difficulty of adjustment. The lack of pulsations in the discharge is a very important point in fuel oil burning, and in this blower the rotors never come in contact with each other or with the casing, which permits high rotative speed without endangering the blower, and consequently reduces the pulsations.

All the work is done by the impeller, which consists of three diamond-shaped blades and a central web, the hub of which is keyed to a steel shaft. This impeller operates in the larger portion of the casing, its blades revolving around a

cylindrical core consisting of two parts, one attached to either end plate, the web of the impeller revolving between them. This forms three pockets in which the air is taken from the inlet and forced over the outlet. Into the end plates are cast leakage pockets, which catch all the air leaking through the clearance spaces, and this air is again caught and carried forward by the following blade. This causes gradual compression, which in turn reduces the pulsations.

The idler does no work. It is located in the smaller part of the casing and consists of a symmetrical casting of three hollow vanes, or blades, whose periphery forms nearly a complete circle. The office of this rotor, revolving at the same speed as the impeller, is to form successively longitudinal spaces, or chambers of the proper size, to permit the impeller



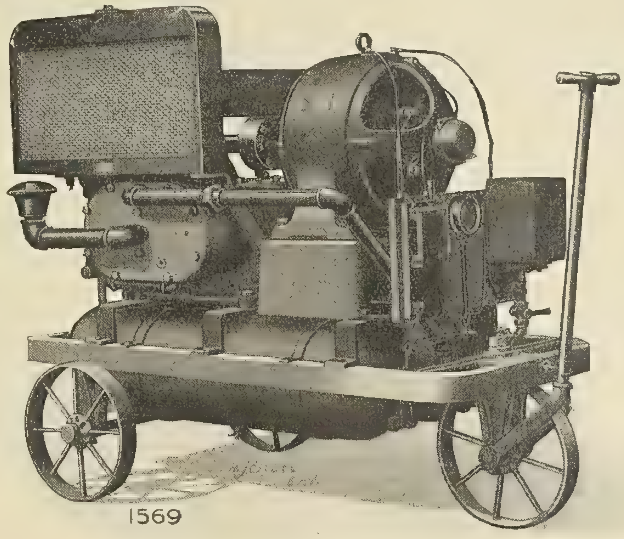
blades to return to the suction side of the blower without allowing the escape of the compresed air. As no work is done by the idler, the only power necessary to be transmitted by the gears is that required to move the idler at the proper speed.

Special care has been given to the design and construction of the bearings, which in the larger sizes are of the wedge block type, easily and accurately adjustable by the simple turning of a set screw. Peek holes are provided, which make adjustment possible without removing the end plates; in fact, many adjustments may be made while the machine is in operation. Oil is supplied by means of chain and ring oilers.

A Portable Air Compressor.

In ship yards, as in other industries, the use of pneumatic tools has proven a prime factor in economically performing certain divisions of the work, such as drilling and riveting, and has indicated the necessity for air-compressing outfits of thorough efficiency and rugged construction. The air compressor herewith illustrated is a National Type "E-1" portable outfit, manufactured by the National Brake & Electric Company, Milwaukee, Wis. This type of compressor is well adapted for service in ship yards and for outside work, where the available space is limited or the nature of the work requires that a supply of compressed air be delivered in different places and under constantly changing conditions. Its installation affords extreme flexibility, as the outfit can be easily hauled from place to place and operated at whatever point it is desired to apply the power. No extensive piping is required, and it is claimed that the cost of maintaining the system is surprisingly low.

The outfit consists of a motor compressor, reservoir and accessories, mounted on a specially built steel truck, with steel wheels and axles. Surmounting the outfit is a galvanized iron pan that provides a suitable receptacle for a length of hose which serves to conduct the compressed air from the reservoir to the place of delivery. Type "E-1" portable outfit, with



a capacity of 50 cubic feet of free air per minute, is equipped with a direct-current motor of standard design and has water-jacketed cylinder and valve heads to adapt it to continuous service. The outfit is also equipped with a radiator type of cooler, thereby providing for a free circulation of water around the cylinders and valve heads, keeping these parts at a minimum temperature.

In order to maintain the air pressure automatically within certain limits, the compressor is provided with an automatic controlling device, by means of which the compressor is started and stopped when the air supply has reached a fixed minimum or maximum pressure. The outfit complete, piped and wired, ready for instant service, includes a motor compressor, steel truck, suction strainer, automatic governor, mica insulator for motor compressor, mica insulator for automatic governor, air receiver, drain and stop cocks, pop safety valves, single-hand gage, single-throw, double-pole knife switch and fuse, hose pan and flexible hose connections, with a pair of couplings.

TECHNICAL PUBLICATIONS.

The Mechanical Engineers' Pocketbook. Eighth edition. By William Kent, M. E., Sc. D. Size, 4½ by 6¾ inches. Pages, 1,461. Illustrations, 218. New York, 1910: John Wiley & Sons. Price, $5 net.

Kent's *Mechanical Engineers' Pocketbook* is too well known to need any introduction to the engineering fraternity. The present edition is of exceptional importance, however, because the entire book has been rewritten, a task which has occupied the author four years. Some 350 pages have been added to the previous edition, and the text has been brought up to date and revised. Notwithstanding the large amount of new material which has been added the book has been brought within the limits of a comparatively small volume through the condensation and elision of much of the old matter and by resetting the tables in more condensed form. A new style of type has been adopted for tabulated matter, which is much more easily read than the old type.

It is hardly possible to more than mention some of the

important changes which have been made in the book, since to examine critically the whole volume would require more space than is available within the limits of this brief review.

The section relating to marine engineering has been changed very little. The figures which appeared in the older editions covering the design and performance of marine engines have been eliminated, since all of the data referred to reciprocating engines. In place of this figures covering the dimensions and performances of notable Atlantic steamers have been included; figures for practice, including the performance of both the boilers, engines and auxiliaries of ships typical of different decades in shipbuilding, have been introduced; also some data regarding the performance of the new Cunarder *Lusitania*. In the section devoted to the screw propeller, Barnaby's method for determining the best dimensions for screws of any speed and horsepower is explained, and an abridged table of data for use in connection with this method has been added.

Considerable change has been made in the section devoted to electricity. Instead of including data which would be useful solely for the electrical engineer it has been the aim of the author to make the section on electricity include only such information as a mechanical engineer should possess in order to handle electrical machinery.

The sections relating to materials, strength of materials and iron and steel have necessarily been considerably changed to conform with the latest engineering practice. Many new tables have been incorporated in these sections, and some of the older tables relating to the strength of materials have been considerably enlarged. In the section on iron and steel the most recent specifications for various grades of iron and steel are included and the new alloy steels are thoroughly discussed.

A large part of the book is devoted to power and its various applications. A new steam table, based on the work of Marks and Davis, has been calculated, dealing with both saturated and superheated steam. New sections covering steam turbines and gas engines are included; smoke prevention is given considerable attention; the problems relating to air, fans, blowers, etc., are made very complete.

The foregoing is but an indication of the many important features of the book, but engineers who are familiar with the earlier editions will realize the value and importance of this new edition.

Engineering of To-day. By Thomas W. Corbin. Size, 5 by 7½ inches. Pages, 367. London, 1910: Seeley & Company, Ltd., 38 Great Russell street. Price, 5s.

This is the sixth volume of a capital series on "Science of To-day." The previous issues met with the highest approval, and the present book, the sub-title of which is "A Popular Account of the Present State of the Science, with Many Interesting Examples Described in Non-Technical Language," is likely to receive a meed of praise equal to that accorded to the previous five volumes. Mr. Corbin is well qualified to deal with the subject of engineering in an authoritative way, and one is attracted by his lucid and interesting style, which is made still more attractive by the accompaniment of some forty illustrations and diagrams.

The introductory chapters deal with "power," and the author writes in a simple yet attractive way on the steam engine, gas engine, running water and power transmission. Then follow sections on various engineering topics and work, and among these a fair amount of space is devoted to marine matters. A preliminary chapter on "Iron and Steel Ships" is followed by two chapters on "The Building of Ships" and "Curious Ships." In the pages on building the author includes an account of the launch of the battleship *Neptune*. The "Curious Ships" described are repair vessels, self-discharging colliers, dredgers and cable-repairing ships. War vessels have a special chapter of fourteen pages, and various types are mentioned. The marine section of the book is concluded by a chapter on "Submarine Diving."

Among other topics touched upon are electric traction, railways, gas manufacture, water supply, lifting and conveying machinery, protection from fire. As indicated above, these subjects are not dealt with for the professional reader, as technical terms are avoided; it is a purely popular exposition of what engineering is in daily life, and as such it is superior to a good many popular treatises which we can recall.

Submarines for the World's Navies. By Charles W. Domville-Fife. Size, 7½ by 10 inches. Pages, 160; illustrations, 61. London, 1910: Francis Griffiths. Price, 21s. net.

The author has gone to a good deal of trouble in collecting as much information as possible concerning the submarine branch of the navies of the world; but we imagine that he has been handicapped in his efforts, both as far as information and illustrations are concerned, owing to the reticence of the several governments with which he has dealt. The first section of the book shows at considerable length how the coast lines of the different countries are defended by submarine torpedo boats, and the boats of Great Britain, France, Russia, United States, Italy, Japan, Germany, Sweden and Spain are considered. Some interesting reference tables are added to this section, with notes on trials containing a description of every naval submarine afloat or in the course of construction. The second part deals with submarine warfare, and this has been added, says the author, to show the tactical value of the daylight torpedo boats. Submarine construction is dealt with in this section, and some interesting skeleton plans are included, showing actual types of vessels. Several papers by well-known writers are given in the last section. These include "Submarines in Open Warfare" (Sir J. O. Hopkins); "Submarines vs. Torpedo Boats" (Sir Cyprian Bridge); "Submarines in Future Naval Warfare" (the late constructor of the French navy); "Submarines" (Lieut. Sir A. Trevor Dawson); "The Arm of the Submarine" (Capt. Edgar Eees); "The Dangers of the Submarine, Real and Imaginary" (Lawrence T. Spear, U. S. N.). Some of these will be recognized as reprinted articles. The book is well printed, and some of the illustrations are excellent, adding value to the book.

Hendricks' Commercial Register of the United States (Buyers and Sellers). Size, 7½ by 10 inches. Pages, 1,342. New York, 1910: Samuel E. Hendricks Company. Price, $10.

The 19th annual Revised Edition of Hendricks' Commercial Register of the United States for Buyers and Sellers has just been issued. It is by far the most complete edition of this work so far published. The 18th edition required 87 pages to index its contents, while the 19th edition requires just 100 pages, or 13 additional pages. As there are upwards of 400 classifications on each page, the 13 additional pages represent the manufacturers of over 5,000 articles, none of which have appeared in any previous edition. The total number of classifications in the book is 35,481, each representing some machine tool specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. The 18th edition numbered 12,220 pages, while the 19th edition numbers 1,344, or 124 additional pages. One hundred and fourteen pages of matter have been omitted from the new edition that appeared in the 18th edition. This makes a total of 238 pages of new matter, the whole representing upwards of 350,000 names and addresses. An important feature of the Register is the simplicity of its classifications. They are so arranged that the book can be used for either purchasing or mailing purposes. The value of the book for purchasing purposes is not confined to its complete classifications alone; it also gives much information following

the names of thousands of firms that is of great assistance to the buyer, and saves the expense of writing to a number of firms for the particular article required. The trade names of all articles classified in the book are also included as far as they can be secured.

The Romance of the Ship. By E. Keble Chatterton. Size, 5 by 7½ inches. Pages, 314. London, 1910: Seeley & Company, Ltd., 38 Great Russell street. Price, 5s.

One is immediately drawn to the very attractive cover which encases this well-written popular exposition. Mr. Chatterton has, during the past few months, been responsible for no less than four fairly good-sized works, and the present volume is a natural outcome of his two previous studies on "Sailing Ships" and "Steam Ships." In the preparation of these two interesting historical books, which have met with much approval, Mr. Chatterton has gathered enough material for his new work, which is a worthy addition to the "Library of Romance." The author has apparently felt the limitations of trying to compact into a single volume all he might say on the evolution of shipbuilding, and he has aimed at giving a picture of the gradual growth of marine propulsion in an attractive and interesting style. He has endeavored to interest his non-technical readers in a subject upon which it is apparent he is most enthusiastic, and his enthusiasm is certainly contagious. Some thirty-four excellent illustrations are included.

COMMUNICATION.

Comment on the Boat Problem.

Editor International Marine Engineering:

We have read your article, "The Boat Problem," by Mr. Walker, with much interest. The only point we should wish to alter his opinion upon is where he states that steel boats will not stand knocking about when lying alongside accommodation ladders the same as a wooden boat will. With a decent rubber our steel boats are quite equal to wooden boats in that respect, and if there is any amount of sea on they are infinitely better. We have had cases where the wooden boats have been stoved in under such circumstances where you could not find any marks on our boats.

Wakefield. The Seamless Steel Boat Company, Ltd.

PERSONAL.

Professor Walter S. Leland, of the department of naval architecture and marine engineering of the Massachusetts Institute of Technology, has tendered his resignation, to take effect at the end of the present term. Professor Leland has been at the Institute for ten and a half years, during five and a half of which he has been a member of the faculty. Soon after the first of the year he will become associated with the San Francisco Bridge Company of San Francisco, Cal., who are affiliated with the Atlantic, Gulf & Pacific Company of New York.

John Haug, consulting engineer and naval architect, has opened an office at 24 California street, San Francisco, Cal. For the last five years Mr. Haug has been engineer-in-chief of the marine department of the Standard Oil Company of California. Previous to that he has spent many years in marine work in Germany, England and the United States, being for twenty years ship and engineer surveyor for Lloyd's Register at Philadelphia.

Duncan Gray Macfarlane, for many years a chief engineer aboard steamships of the Cunard Line, has just retired, having reached the age limit for service. For the last five years Mr. Macfarlane has served as chief engineer of the *Caronia.* When Mr. Macfarlane first joined the Cunard Line in 1872, he was assigned to the *Scotia,* a side-wheel steamship, and was with her during the last five years of her existence as a North Atlantic passenger steamship.

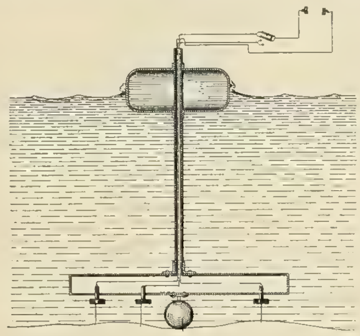
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

964,380. APPARATUS FOR SUBMARINE SIGNALING. THOMAS JAMES BOWLKER, OF BOSTON, MASS.

Claim 1.—The combination of a pair of transmitters submerged in water and sensitive to sound waves passing through said water, a pair of receivers connected with said transmitters and adapted to be applied to the ears of an operator, and connections from said transmitters to



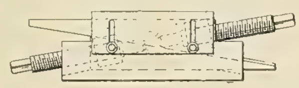
said receivers, said transmitters being spaced apart by a distance representing the proximate distance apart of said receivers multiplied by the ratio of velocity of sound in water as compared with the velocty of sound in air. Seven claims.

967,741. COMBINATION DREDGE AND CONVEYER. FRANKLIN P. EASTMAN, OF NEW YORK, N. Y.

Claim 1.—A combination dredge and conveyer, comprising a bucket mounted to swing and to travel bodily to and from the material to be removed, means for drawing the bucket forward and backward, the bucket on its forward movement passing into the material at the time the mouth of the bucket is in an approximately vertical position, and means for returning the bucket to normal upright position. Five claims.

965,302. KEEL-BLOCK. PHILIP KEYMER, OF CLEVELAND, OHIO.

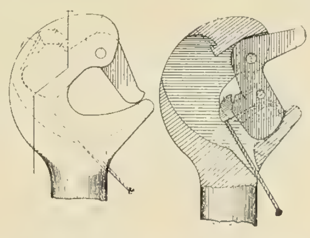
Claim 2.—A keel block comprising a pair of wedge members, a screw rod having right and left hand threads thereon, nuts on said threads, one of said nuts connected to a lower wedge member, another of said nuts



connected with an upper wedge member, the connections of said nuts and wedge members permitting a change in the inclination of said screw rod. Eight claims.

965,655. BOAT-RELEASING HOOK. JOSEPH YATES PORTER, JR., OF KNIGHTS KEY, FLA.

Claim 2.—A boat-releasing hook comprising a rigid hook body having a lateral oepning; a finger pivotally mounted in said body to close said opening; a tail piece rigidly connected with said finger; a movable latch member pivotally mounted in said tail piece to engage said hook body



when said finger is in position to close said opening; a flexible transmission member connected to said latch and to an operating station removed from said hook; and a projection mounted on said tail piece and extended to support and guide said flexible member within said hook body. Three claims.

966,654. SCREW-PROPELLER. CLEMENT COMA, OF PARIS, FRANCE.

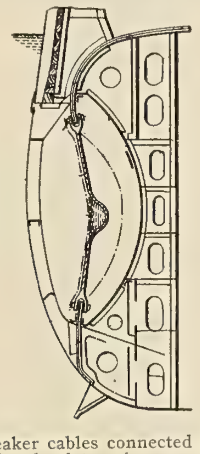
Claim.—In a screw propeller for ships and such like, the combination with a shaft, of a plurality of propellers mounted on said shaft, said propellers comprising a hub and a plurality of blades, a truncated member secured to said shaft, a plurality of helical propeller blades fastened to said member, the width of said helical blades increasing toward the larger end of said member. One claim.

970,368. MEANS FOR DAMPING THE ROLLING MOTION OF SHIPS. HERMAN FRAHM, OF HAMBURG, GERMANY.

Claim 6.—In ships, means for damping rolling, comprising water vessels widening toward their upper ends, a cross connection joining the lower ends of said vessels, a cross pipe joining the upper closed ends of said vessels, and means for throttling the passage of air through said last-mentioned cross pipe. Twenty-three claims.

966,813. SHIP OR VESSEL. GIOVANNI EMANUELE ELIA, OF PARIS, FRANCE.

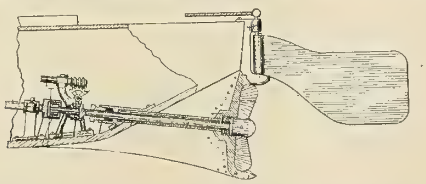
Claim 1.—A device for protecting ships from the effects of submarine explosions, comprising a chamber extending around the portion of the ship to be protected, a plurality of strong cables aranged within the said



chamber, and rows of weaker cables connected to the aforesaid cables in such manner as to retain the latter in a partly contracted condition. Thirteen claims.

965,870. PROPELLER AND BOAT CONSTRUCTION. WILLIAM L. CASADAY, OF SOUTH BEND, IND.

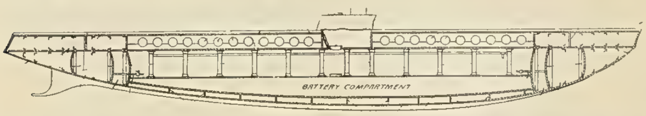
Claim 1.—Propelling mechanisms for boats embracing a propeller, a stern post adapted to be secured to the boat and shaped to fit to the inner edges of the buckets of the propeller as the same revolves and to



afford continuous cutting edge for the entire length thereof in conjunction with the edges of the buckets and a downward and rearward extension secured to said stern post extending beneath the propeller and rearwardly therefrom. Nineteen claims.

970,064. SUBMARINE BOAT. SIMON LAKE, OF MILFORD, CONN.

Claim 6.—A submarine boat, comprising an inner hull section, and an outer hull section of the same length, constructed to resist external pressure when the boat is submerged, bow and stern portions extending from the hull sections, a storage battery compartment arranged centrally

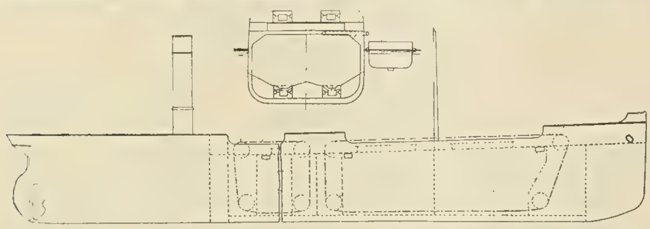


in the space formed between the hull sections, ballast tanks formed in the said space, means for admitting water to the said tanks, means for emptying said tanks, a superstructure of light weight construction arranged over the hull sections and means for admitting water into the superstructure space. Seventeen claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

11,970. VESSELS FOR CARRYING BULK CARGO. P. B. CLARKE, LIVERPOOL.

The vessel is fitted with conveyors which extend along the bottom of the holds, up and down at each end, and over the hatches. The lower run passes over wheels, and the upper run over similar wheels. The bottom of the vessel has sloping platforms each side of the lower part



of the conveyors, on which the cargo rests, and they feed it to the conveyor, which is supported on rollers and runs between rails. Laterally disposed conveyors are arranged in connection to convey the material supplied, by conveyors, overboard.

1433. COMBINED AHEAD AND ASTERN TURBINES. BROWN BOVERI ET CIE., BADEN, SWITZERLAND.

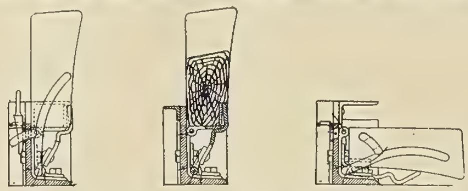
By this invention, ahead and astern turbines are placed within a common casing, with their exhaust ends adjacent and separated by a partition, which is provided with a packing at the part where the shaft passes through, and there are chambers within the packing connected so that any steam leaking through a part of the packing is conducted to the low-pressure stage of another turbine, to the condenser or to the atmosphere.

15,977. POWER-DRIVEN BOATS. SIR J. I. THORNYCROFT AND T. THORNYCROFT, CHISWICK.

This boat has its bow portion more or less of the ordinary contour, this contour extending rearward to about the center, where the under side of the boat suddenly turns upwards and then backwards, merging into a flat horizontal stern portion, below which the propeller and its shaft extends. When the boat is at rest or traveling at a moderate speed the forward portion is well immersed and the rearward portion is immersed less and less from the upwardly extending shoulder. Upon the boat being driven at a greater speed, the forward portion rises until at or above a predetermined speed the boat is supported only by the lower portion adjacent to and forward of the shoulder, and by the more or less flat rearward portion, an air space being left below the upwardly and backwardly curved middle portion between these parts.

18,851. BOAT DISENGAGING AND SUPPORTING GEAR. W. JAMES, SOUTH SHIELDS.

Relates to chocks; these are hinged at their lower parts so that when unsupported they fall over by gravity and leave the boat clear. They are supported in the raised position by plates fixed to a rod provided



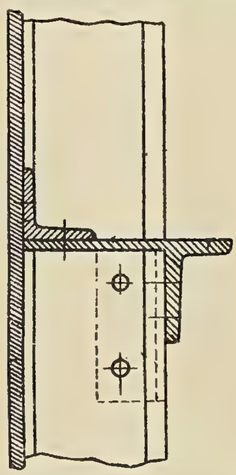
with a hand lever by which the rod can be turned so as to raise the supporting plates, and thereby the chocks. For securing the chocks in the raised position a pin is thrust into a slot of the lever.

19,754. BRAKES FOR SHIPS' RUDDERS. C. A. JACKSON, EAST BOLDON, DURHAM.

This invention relates to means for preventing shock to the gear when a sea strikes the rudder. It comprises a cylinder filled with liquid and furnished with a piston having a piston rod extending through each end of the cylinder, the ends of the cylinder being connected by a valve-controlled passage. When the rudder is moved over to either side the cylinder is moved relatively to the piston, or *vice versa*, and the flow of liquid displaced from one side of the piston to the other is impeded more or less.

27,146. IRON SECTION FOR SHIP BUILDING. W. OVERHOFF, SAN ROCCO, NEAR TRIEST.

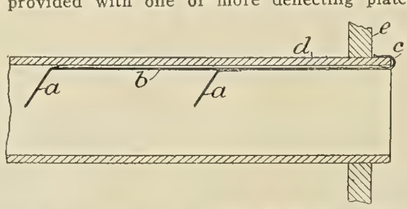
This section is characterized by a cross flange arranged at one side of the web, which is wider and thinner than the web, and the other cross



flange; further a sharp right angle is formed between the web and wider cross flange.

22,120. MEANS FOR DEFLECTING THE DRAUGHT IN THE TUBES OF MARINE AND OTHER BOILERS. T. M. BROOM, GREENOCK.

This deflector comprises a strip or plate adapted to be clipped to the tube-end and provided with one or more deflecting plates of substan-



tially semi-circular form. One end of the strip is provided with a hook-shaped clamping spring for attachment to the tube.

16,553. DISCHARGE OF ASHES BELOW THE WATER LINE. F. J. WHITE, WOODFORD.

This is an apparatus of the kind comprising a continuously or intermittently driven chambered cock, or valvular device, and the invention consists in the combination with a lubricator for the valvular device, the lubricator being of the kind comprising a lubricant ejecting piston having a step by step feed, and a variable crank for driving it and enabling the working to be suited to various conditions.

International Marine Engineering

DECEMBER, 1910.

LAUNCH OF THE OLYMPIC.

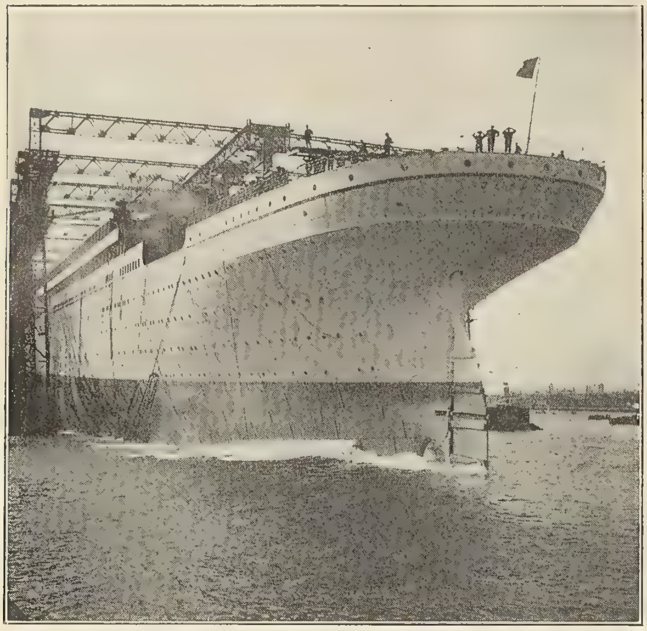
The most important launch of the year took place October 20th at the yards of Messrs. Harland & Wolf, Belfast, Ireland, when the giant 60,000-ton White Star liner *Olympic* left the ways. The *Olympic* is not only the largest ship in the world but she is as well the most notable example of the adoption of the combination system of turbines and reciprocating engines for propulsion.

The actual launch, from the time the vessel first began to move until she was completely waterborne, occupied sixty-two seconds. She moved steadily all the time, attaining at her highest speed on the ways a maximum rate of 12½ knots. When her stern was at its deepest immersion it was drawing 34 feet 6 inches of water, and when her bow left the ways it dipped to the extent of 18 feet 9 inches. Her mean draft as she lay in the river after launching was 18 feet ½ inch. The declivity of the ways was ⅜ of an inch per foot forward and ½ inch aft. For greasing the ways about 22 tons of tallow were used. The vessel was stopped within less than her own length without throwing any serious strain on the check chains or the anchors.

THE LARGEST STEAMSHIP IN THE WORLD, IMMEDIATELY AFTER LAUNCHING.

Like all the White Star boats, the *Olympic* is graceful, and only by comparison with other ships can her magnitude be appreciated. The launching weight, about 27,000 tons, was the heaviest weight ever tranferred from land to water, and this operation was naturally an undertaking of unusual importance, requiring the greatest forethought and most expert preparations. The method of launching was simple. The vessel was held on the ways by hydraulic triggers, only requiring to be released by the opening of a valve in order to allow the vast structure to glide into the water. The arrangements in launching did not end with the release of the vessel. They included provision for checking the way on the vessel when in the water. In the bed of the river were placed three heavy anchors on each side of the ship, each anchor being connected by a 7-inch steel wire hawser to eyeplates riveted to the shell plating. There were also placed in the bed of the river two piles of cable drags, each weighing over 80 tons, connected in a similar manner with an 8-inch steel-wire hawser. These were so arranged that when the vessel was clear of the end of the slip the drags and anchors acted simultaneously in bringing the ship to a standstill. The ship's own bow anchors were stowed in the hawse pipes, ready for letting go in case of emergency. So effectual were these methods that from the time the triggers were released, allowing the vessel to move, until the *Olympic* was stationary in the water, less than a couple of minutes elapsed. And as a feryman remarked to the writer, she made no more wave than his own old scow.

In the *Olympic* Harland & Wolff have repeated an achieve-

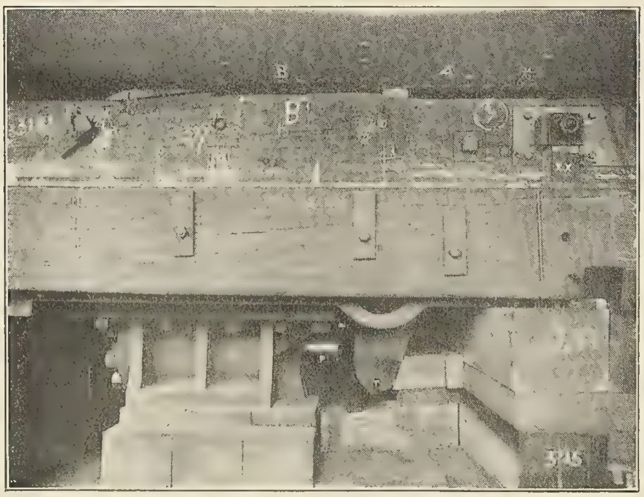


LAUNCH OF THE OLYMPIC.

ment already to their credit several times in the course of their history. Once more they have launched the largest vessel in the world. The White Star liner *Olympic* and her sister ship the *Titanic* are much larger than the *Lusitania* and the *Mauretania*. They are not intended to be fast ships, but they are notable as great specimens of naval architecture. The *Olympic* is of the following dimensions:

Length over all	882 ft. 6 in.
Breadth over all	92 ft. 6 in.
Breadth over boat deck	94 ft. 0 in.
Height from bottom of keel to boat deck	97 ft. 4 in.
Height from bottom of keel to top of captain's house	105 ft. 7 in.
Height of funnels above casing	72 ft. 0 in.
Height of funnels above boat deck	81 ft. 6 in.
Distance from top of funnel to keel	175 ft. 0 in.
Number of steel decks	11
Number of water-tight bulkheads	15
Gross tonnage	45,000 tons
Displacement at 34½ feet draft	60,000 tons

Apart from the *Lusitania* and the *Mauretania* one need not compare the *Olympic* and the *Titanic* with any vessels outside the White Star fleet. The development of the modern large intermediate steamer can be shown within that fleet. It dates from the *Oceanic* in 1899, and progress in size may be traced by taking a list of the White Star vessels and the Cunard express boats:

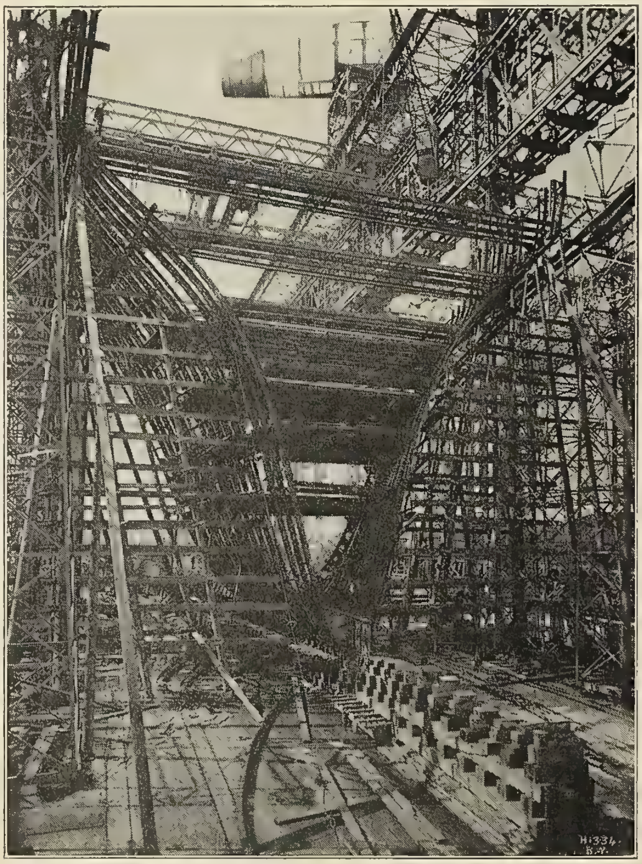


HYDRAULIC LAUNCHING TRIGGER.

Vessel and Type.	Tons.	Length.	Breadth.	Depth.	Speed.	Year.
Oceanic, T. s.s.	17,274	686	68	44	20	1899
Celtic, T. s.s.	20,904	681	75	44	17	1901
Arabic, T. s.s.	15,801	600	65	47	16	1903
Baltic, T. s.s.	23,876	709	75	52	17	1904
Adriatic, T. s.s.	24,541	709	75	52	18	1906
Laurentic, 3 scr.	14,892	550	67	41	17	1908
Mauretania, 4 scr.	31,938	762	88	57	25	1907
Olympic, 3 scr.	45,000	*882	92	62	21	1910

* Over all.

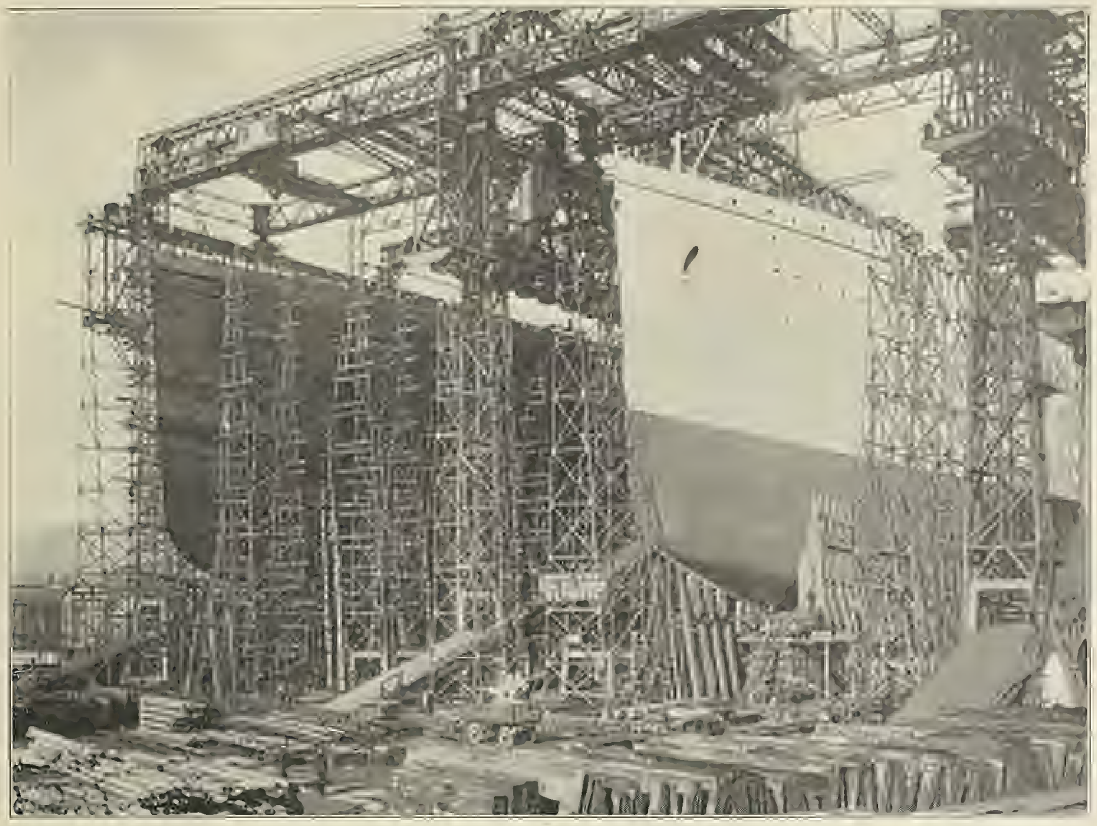
The *Celtic*, it may be recalled, has a sister ship, the *Cedric*, and the *Laurentic* a sister ship the *Megantic*, just as the *Olympic* and *Mauretania* have sister ships. The *Laurentic* and *Megantic* have triple-screw combination engines and the *Mauretania* and *Lusitania* have quadruple-screw turbines. The *Laurentic* and *Megantic* were built for the Canadian service and so do not mark a step in advance in the matter of size or speed, but otherwise the progress made has been continu-



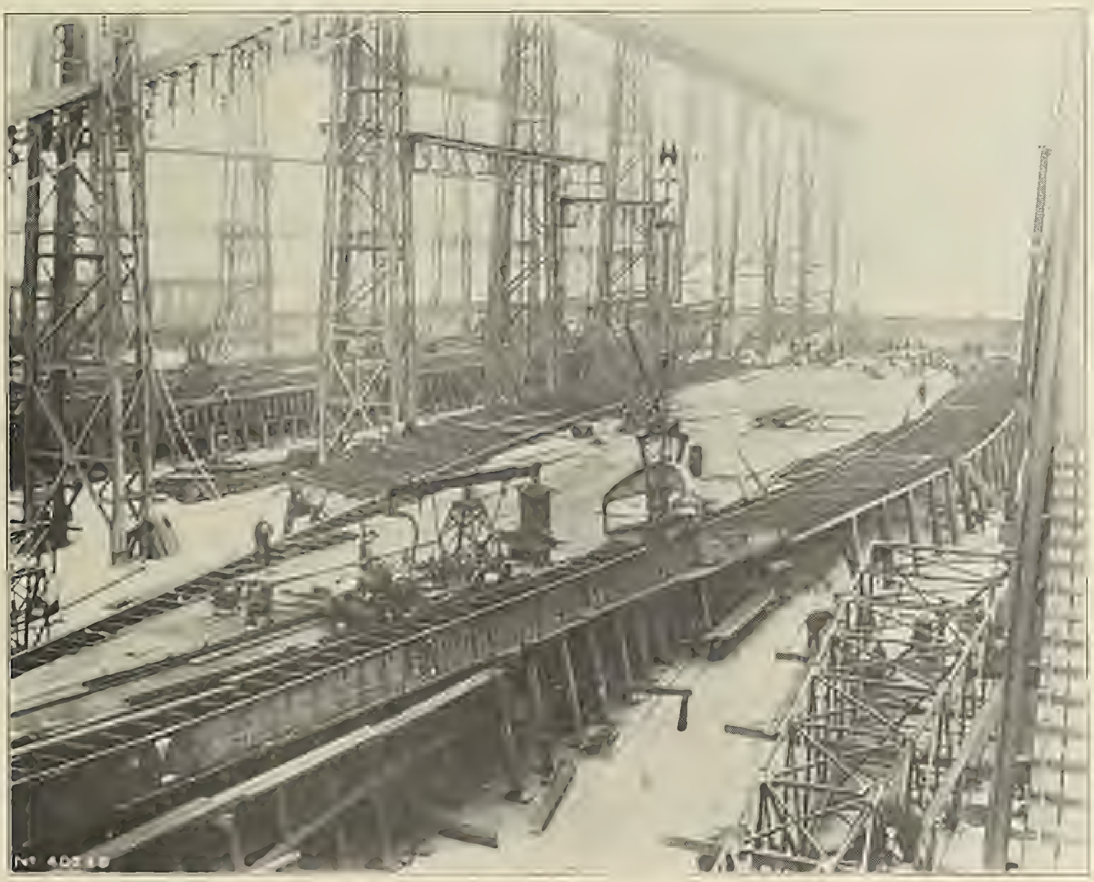
ERECTION OF FRAMING.

ous. In speed the White Star Line have left the field to the Cunard and other companies. Although the *Olympic* is the largest vessel ever built her size does not alter the fact that she is very graceful.

Besides being the largest and heaviest vessel ever launched, the *Olympic* is also the strongest. Both in design and workmanship strength has been kept in view. The most improved structural arrangements have been adopted, and every mechanical device used to secure this. The double bottom, extending the whole length of the vessel, is 5 feet 3 inches deep (increased under the reciprocating engine room to 6 feet 3 inches). The massive beams and close framing, the large shell plates, the steel decks and watertight bulkheads, combine to make a structure of exceptional strength and rigidity. The hydraulic riveting is also an important factor. The whole of the shell plating up to the turn of the bilge was riveted by hydraulic power, and also an immense amount of it in other parts of the vessel—the shell, the top sides, the decks and the stringers. The rivets were closed by means of powerful 7-ton



THE OLYMPIC AND TITANIC UNDER CONSTRUCTION AT BELFAST.



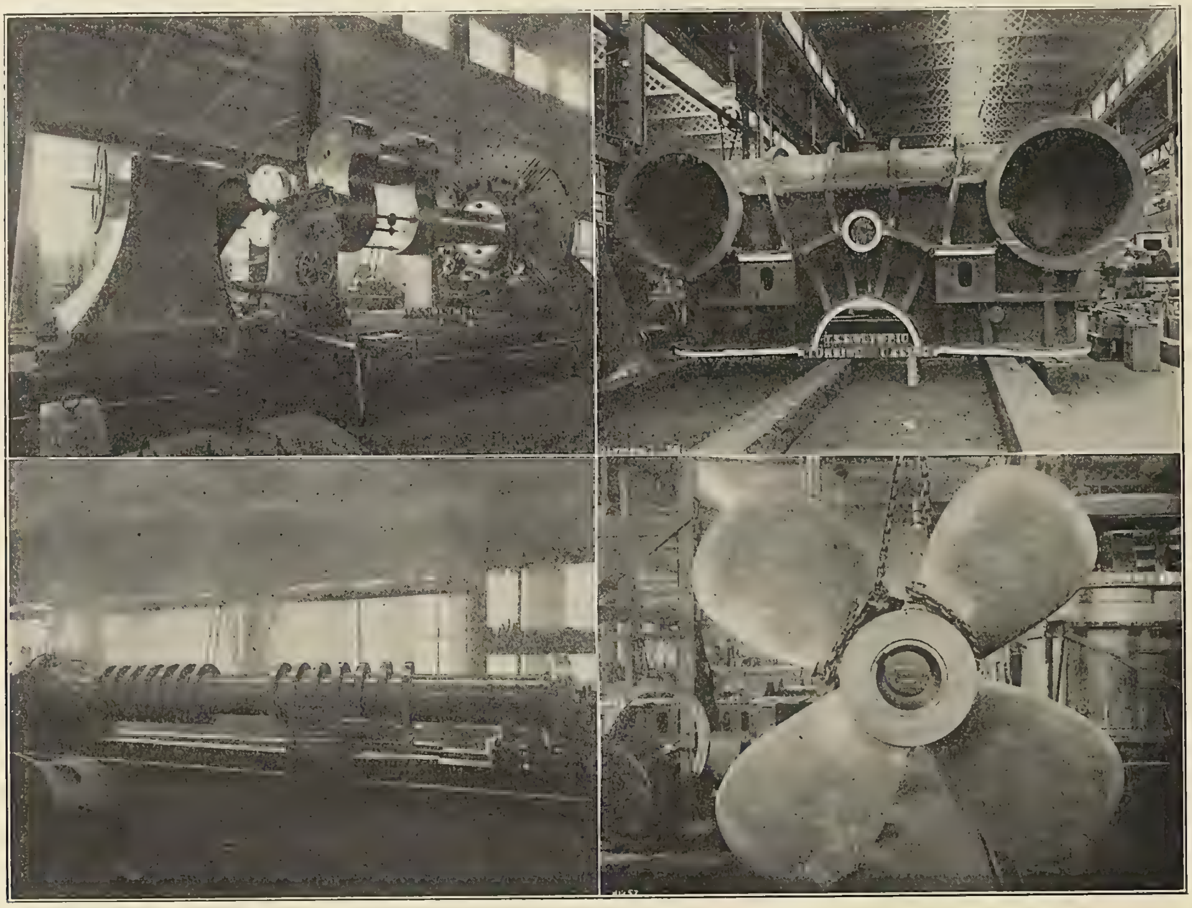
TANK TOP AND WING TANK FLOORS.

riveting machines suspended from the traveling cranes on the gantry. There are half a million rivets in the double bottom alone, weighing about 270 tons. The largest rivets are 1¼ inches in diameter. In the complete ship there are some three millions, weighing about 1,200 tons.

The largest shell plates are 36 feet long and weigh 4¼ tons each; the largest beam is 92 feet long, the weight of the double beam is 4 tons; the stern frame weighs 70 tons. The after boss arms weigh 72½tons; the forward 45 tons. The rudder weighs 100 tons; the engine crank shafts 118 tons each; the bedplate 195 tons; the columns 21 tons each; the heaviest cylinder, with liner, 50 tons; the wing propellers each 38 tons, finished weights. The castings for the turbine cylinder weighed 163 tons, and that for the center (turbine) propeller, which is of solid bronze, 22 tons.

The double bottom is built with continuous frames and floor plates with intercostal longitudinals. Exclusive of the margin plates and center keelson, there are eight longitudinals, while in the machinery space special girders have been added. Above the tank top the framing of the vessel consists of 10-inch channel bars spaced 36 inches apart. This framing is lightened at the ends of the vessel, while every few frame spaces throughout the length of the hull there are heavy web frames consisting of web plates joined to the shell by double angles and reinforced at the inner edge by double angles. In the machinery space the web frames are spaced closer together than in the holds. The lower deck beams are 10-inch channels fitted to every frame and supported by four longitudinal girders. These longitudinals are in turn supported by stanchions between the decks.

The rudder is 15 feet 3 inches wide and weighs 100 tons. The diameter of the rudder stock is 23½ inches.



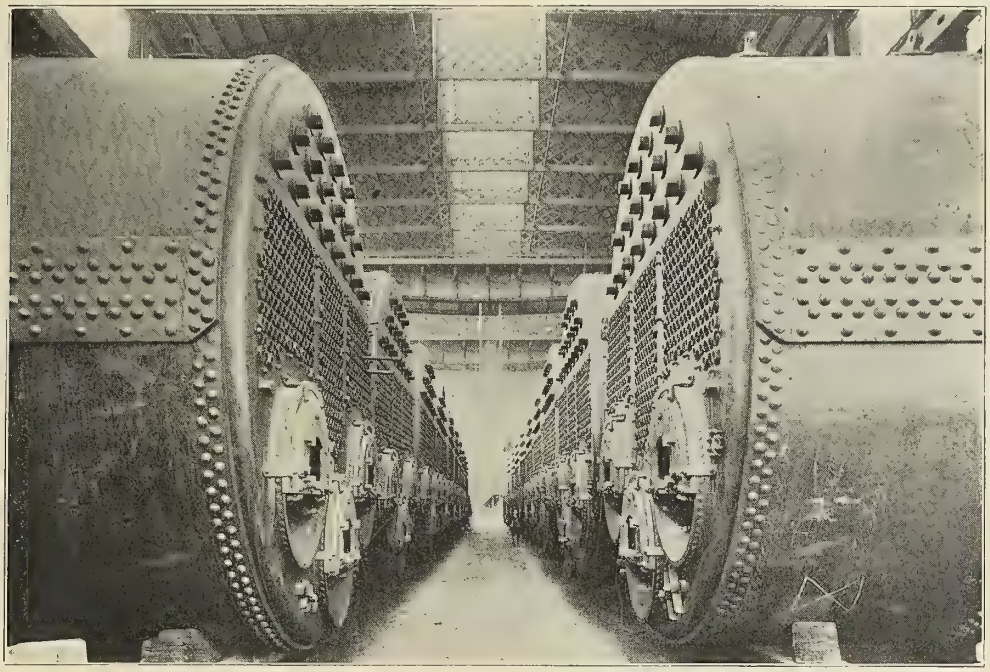
CRANK-SHAFT.
THRUST-SHAFT.

TURBINE CASING.
TURBINE PROPELLER.

There will be accommodation for about 2,500 passengers, besides a crew of 860. There will be over 2,000 sidelights and windows in the ship, and the sumptuous character of the appointments will be in keeping with the traditions of the line. Both the public rooms and private cabins, and the entrances, the magnificent staircases, and other features will be on a scale of magnitude and excellence.

One of the upper decks is to be completely enclosed as a ballroom, or as a skating rink or theater, and the rest of the accommodation is on the scale of the best first-class hotels. Not only will it be possible to obtain cabin suites, but one may travel in a complete flat, comprising bedroom, sitting room or parlor, private baths, and even a private library, with, of course, private meals. Then for the vigorous there are cabins with private shower baths, a great swimming bath and a gymnasium, while on one of the upper decks astern there is to be a veranda café, after the manner of the open-air cafés of Southern Europe, with an orchestra and an organ to furnish music. For lady passengers a modistes' parlor and jewelery store are to be open to first and second class passengers, with a tailor's shop for the gentlemen. There are, of course, nurseries for children.

The vessel will be fitted throughout with double-banked boats, operated by the new Welin gear, the first twelve sets of which type were fitted on the new steamers recently ordered by the Union-Castle Line. The davits are of the double-acting type, each vessel carrying sixteen sets, or enough davits to handle thirty-two lifeboats, and twin frames, provided with a special arrangement for manipulating either davit arm without shifting the handle, are to be used between the boats. The outboard boats will rest on shifting chocks, extending half outboard at sea, thus leaving between the two rows of boats a



BOILERS.

clear passage of about 5 feet. All the inward boats are extras, fitted in addition to the regulation complement.

The machinery for the *Olympic* and the *Titanic* is the combination of reciprocating engines with a low-pressure turbine, the same as adopted in the White Star Canadian liner *Laurentic*. This arrangement has proved satisfactory from an engineering point of view, and, at the same time, eliminates vibration and secures comfort by smooth working of the ship.

Steam is supplied at a pressure of 215 pounds per square inch by twenty-four double-ended and five single-ended Scotch boilers, each 15 feet 9 inches diameter and 20 feet and 11 feet 9 inches long, respectively. Each of the single-ended boilers has three Morison furnaces, and each of the double-ended boilers six furnaces. The furnaces are all 45 inches inside diameter. The longitudinal seams are triple-riveted double-butt strap joints, and the circumferential seams double-riveted lap joints; the boiler heads in the steam space are stayed by eighteen through stays, the tube plates being stayed by the usual stay tubes. Each furnace leads to a separate combustion chamber, and the boilers are to be operated under natural draft.

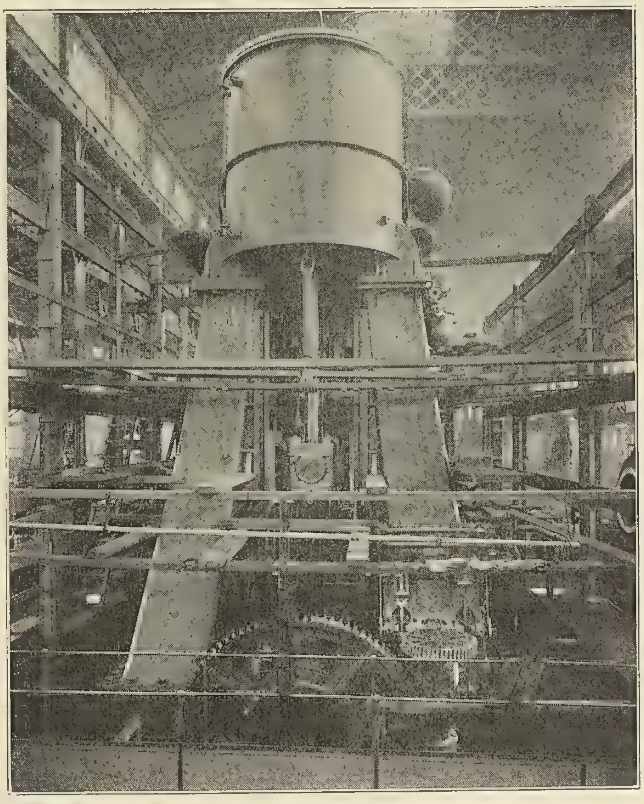
The boilers are located in six watertight compartments, the firerooms being athwartship. The products of combustion are led to three stacks, 24 feet 6 inches by 19 feet by 160 feet high, above the grates. A fourth stack is provided for ventilating purposes and to take care of the products of combustion from the galleys. The stokeholds are ventilated by Sirocco fans, two being located in each fireroom.

Coal is stored in 'thwartship coal bunkers between the boilers and a reserve supply is carried in side bunkers between decks. See's ash ejectors are fitted for use at sea, and Campbell's ash hoists for use in port.

The boiler arrangement is designed with special reference to economy and safety, since the auxiliary machinery for port use is supplied with steam from a single boiler room, but by means of connections to the other boiler rooms certain boilers in each compartment can be used for this purpose. This would enable the operation of the auxiliary machinery in event of flooding part of the boiler space.

Propulsion is by the combination system of reciprocating engines and low-pressure turbine, the three-shaft arrangement being adopted with two four-cylinder, triple-expansion reciprocating engines on the wing shafts and a single Parsons turbine on the center shaft. The reciprocating engines are located in a separate compartment just aft of the boiler space. The turbine, together with the condensers and part of the auxiliary machinery, is located in a separate compartment immediately aft the reciprocating engine room.

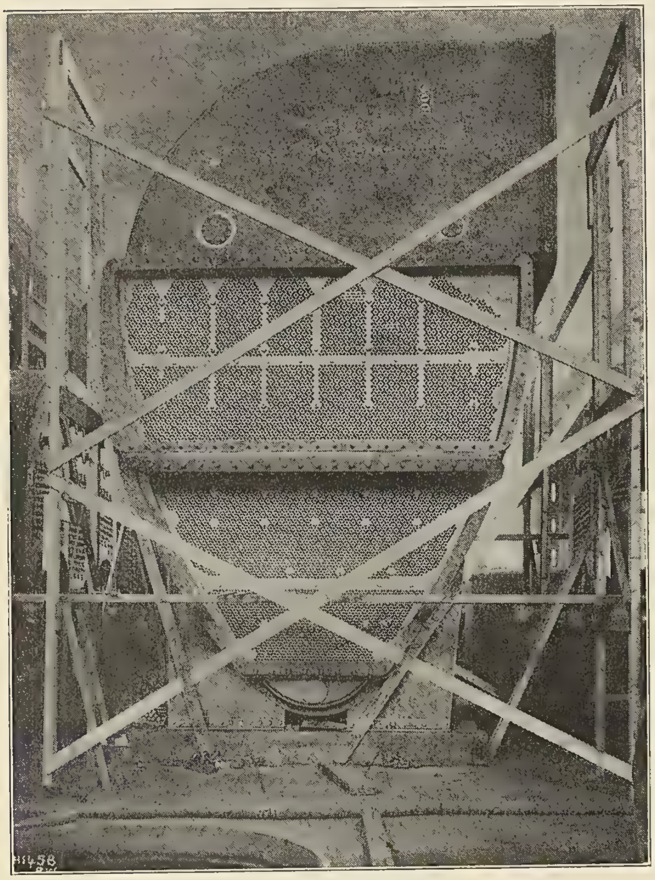
The reciprocating engines have cylinders 54 inches, 84 inches, 97 inches and 97 inches diameter, with a stroke of 75 inches. There is a low-pressure cylinder at each end of the engines, with the high-pressure and intermediate-pressure cylinders be-



STARBOARD ENGINE.

tween, the high-pressure being forward of the intermediate-pressure. The high and intermediate-pressure cylinders are fitted with piston valves, one for the high and two for the intermediate, and the low-pressure cylinders with twin slide valves. All the valves are operated by the Stephenson double-bar link motion.

The crank shafts are 27 inches in diameter, the thrust shaft



PEAR-SHAPED CONDENSER.

is also 27 inches in diameter and has a bearing in the center of the thrust block. The propeller shafting is 26¼ inches diameter, and the tail shaft 28½ inches. The wing propellers are 23 feet 6 inches diameter, and are designed to run at 75 revolutions per minute.

The turbine which receives the exhaust steam from the low-pressure cylinders of both reciprocating engines is of the latest Parsons design, the rotor being 12 feet in diameter and 13 feet 8 inches long. The turbine shaft is 20 inches in diameter and the tail shaft 22½ inches. The turbine propeller is a solid manganese bronze four-bladed wheel, 16 feet 6 inches diameter, designed to operate at 165 revolutions per minute.

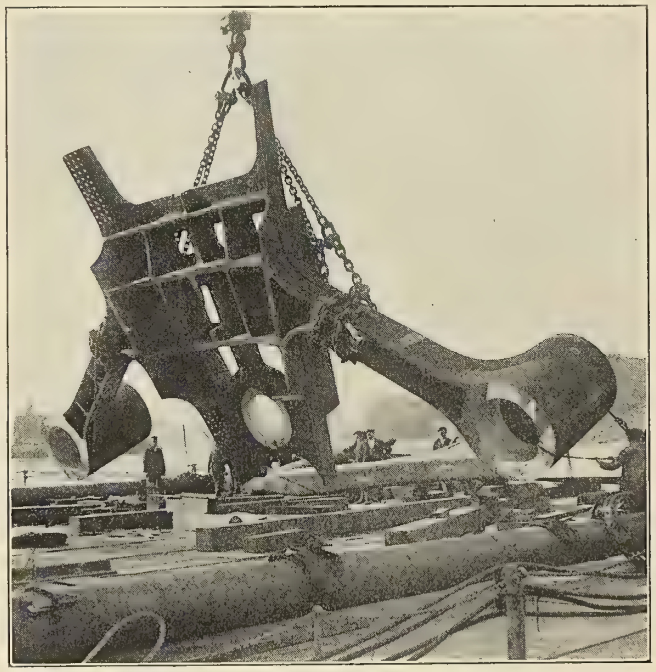
There are two main condensers of the inverted pear-shaped type, such as are usually constructed by Messrs. Harland & Wolff. This type of condenser brings the largest volume of cooling surface at the point where the exhaust steam enters the condenser, therefore making the most efficient disposition of the condensing surface. Centrifugal circulating pumps, driven by compound reciprocating engines, are installed, and the air pumps are of Weir's dual type.

An elaborate refrigerating installation, consisting of two horizontal duplex CO_2 machines, is located on the port side of the reciprocating engine room.

The electrical plant consists of four sets of 400 kilowatts capacity each, placed aft of the turbine engine room. These are supplemented by two sets of 35 kilowatts capacity, each located on one of the upper decks above the load waterline for use in case the main generating plant should be damaged or flooded in a collision.

The launch of the *Olympic* brings the tonnage of the White Star Line up to 418,907 tons, a fleet remarkable for its efficiency and modern character, including twin-screw and triple-screw steamers of the latest type, and one fine sailing ship, employed in the important work of training officers.

The exceptional size of the *Olympic* involved the construction of a new graving dock in Belfast to receive her, and the deepening of the Victoria Channel, at an estimated outlay of $146,000 (£30,000), to permit her safe outlet from and inlet to the harbor. She, with her sister ship the *Titanic*, called for the construction of special slips, three of the previously largest at Queen's Island being converted into two and piled and strengthened to such an extent that they are capable of supporting no less than 70,000 tons. It was also necessary to erect a double gantry (one of the most striking features of the port), 840 feet long, 105 feet wide, in each of the two berths, and 220 feet in height at the tallest point of the cantilever crane. The gantry is equipped with cranes and traveling frames, capable of lifting loads from 5 tons to 40 tons, and is supplied with special stagings, platforms and electric cranes. There was also the necessity of providing, at great



AFTER BOSS ARMS.

cost, the floating crane which will transfer the boilers to the new ship, of reconstructing several sections of the works on an extensive scale, of designing and fitting up a considerable quantity of special plant, and of carrying out a variety of alterations in the works to enable the builders to complete their gigantic undertaking. The outlay involved in the building plant of the new liners means an aggregate expenditure of between $1,950,000 (£400 000) and $2,200,000 (£450,000).

The Belfast Harbour Board had to make elaborate arrangements for the safe launching of the *Olympic*. They spent $292,000 (£60,000) before the works undertaken were completed. These works included the deepening of Victoria Channel to a depth of 32 feet at a cost of $146,000 (£30,000), the provision of an embankment opposite the entrance basin of the new graving dock, a suitable turning basin for the vessel, the laying of a tramway to the deep-water wharf to carry material

for the fitting out of the liner after she is launched, and the dredging of the river at the slip where the *Olympic* was built. A depth of 50 feet had to be reached opposite the berth for the plunge of the liner's stern before her bow reached the water. In addition Harland & Wolff spent over $48,670 (£10,000) in strengthening Victoria Wharf, which is situated at the entrance to the *Olympic* berth, so as to avoid any danger of its collapse when the vesel reached the water. Special arrangements were made for the launching of the vessel. To prevent the launching ways yielding under the immense weight, two cradles were riveted to the hull and launched with the ship. At the bow two hydraulic jacks, with a lifting capacity of 1,000 tons each, were placed and were brought into use just a few moments before the actual time of launching.

The keel of the *Olympic* was laid on December 15, 1908, and the framing was completed on November 20, 1909. The *Titanic* is completely plated and will be launched in about six months. It is hoped that the *Olympic* will be ready for her trials in July. Both ships will be employed on the Southampton-New York service.

TEST OF A BABCOCK & WILCOX MARINE BOILER.

The following abbreviated abstract, governing bids and contracts for watertube boilers, built for naval purposes, explains the reason for certain exhaustive boiler tests having been performed recently with boilers intended for United States vessels.

"*Guaranteed Boiler Efficiencies.*—Accompanying all bids. .... there will be required specific guarantee of the evaporative efficiencies of the boilers proposed when burning coal at the rate of 15, 25, 35 and 40 pounds per square foot of grate surface per hour.

"At the highest rate of combustion the rate of evaporation from and at 212 degrees F. must not be less than 11 pounds of water per hour into dry steam per pound of combustible. * * *"

In pursuance of an established practice, and in accordance with foregoing requirements with respect to the boilers contracted for and now building by the Babcock & Wilcox Company, Bayonne, N. J., for the U. S. S. *Arkansas* and *Wyoming*, a boiler of a type similar to the boilers to be used was thoroughly tested out recently at the works of the company.

The boiler tested was of the following dimensions:

Grate surface........	57.8 square feet
Heating surface......	2,755 square feet
Length of grate......	7.00 feet
Width of grate......	8.27 feet
$\frac{\text{H. S.}}{\text{G. S.}}$	47.7
Steam pressure......	210 pounds per square inch

A board of officers consisting of Commander C. W. Dyson, Lieutenant-Commander John K. Robison and Lieutenant H. C. Dinger, was appointed by the Secretary of the Navy to conduct and control the tests carried out by the contractors.

The boiler was erected in a test house adjoining the power house. All necessary appurtenances and instruments for carrying on the test were arranged for. These consisted of forced-draft blower, feed heater, feed and weighing tanks, platform scales for weighing the coal, air pressure gages and pyrometers, and Orsat gas analysis apparatus, calorimeter, thermometers, etc. All necessary calibrations had been performed before the test was undertaken. The blower for supplying the forced-draft discharged at the floor line at the back of the boiler and against a baffle which deflected the air upward. The main steam pipe had connection both to the steam main of the powerhouse and to the atmosphere through a muffler. A Reilly feed heater was installed for heating the feed water, a branch pipe leading to it for supply of the necessary steam. The pressure was regulated by a valve in the steam connection to the heater. A steam connection from the main steam pipe led to a jet in the smoke pipe for the purpose of creating artificial draft.

The smoke up-take led to a stack 19.6 square feet of cross-sectional area and 100 feet in height above the grate. There were placed in the feed pipe close to the boiler thermometers for obtaining the temperature of the feed water. Nitrogen-filled thermometers were located in the up-takes to obtain the temperature of the gases of combustion.

A Barrus throttling calorimeter was located in the main steam pipe, about 18 inches from the boiler. The temperature of the steam from the boiler and at the escape from the calorimeter was ascertained by the usual arrangement of upper and lower thermometers.

The pressures of the gases in the first and third passes was ascertained by inserting tubes connecting to an air gage through the dusting doors communicating with said parts of the boiler. For the gas analysis an Orsat apparatus was used. The gas samples were taken from the up-takes through a small pipe leading to the Orsat.

The coal was weighed on platform scales placed in the air lock. Each barrow contained an even weight of 200 pounds of coal. An estimate was made of the amount of coal on the floor at the end of each hour.

The water used in the boiler was taken from the city main. The arrangement for weighing the amount fed to the boiler consisted of two tanks mounted on platform scales and placed directly over a rectangular feed tank, into which the contents of the weighing tanks were dumped after the weight had been ascertained. The boiler feed pump had a suction from the feed tank, the discharge being led through the feed heater to the boiler. The actual amount of water was checked at the end of each hour.

The moisture of the steam generated by the boiler was figured from the following formula:

$$Q = \frac{.48\ (T - t)}{L} \times 100, \text{ in which}$$

Q = percent of moisture,

T = calibration reading of the lower thermometer,

t = test reading of the lower thermometer,

L = latent heat of steam at boiler pressure.

The moisture in the coal was determined by laboratory tests from samples taken for each test.

Ash pans were cleaned at the beginning of each test. Shortly before the end of each test the fires were cleaned and brought to a condition as nearly as possible to that at its beginning.

THE TESTS.

In all six tests were made, the first four being those required by the contract, namely, at the following rates of combustion: 15, 25, 35 and 40 pounds of coal per square foot of grate per hour. Each test was of twenty-four hours' duration.

The fifth test was for the maximum capacity of the boiler and continued for three hours.

In the sixth test the rate of combustion was 45 pounds per square foot of grate per hour, the grate at the back end then being 6 inches lower than during the previous tests.

The alternate method of starting and stopping the test was employed in the first test, but in all succeeding tests the flying start was employed. All data were taken simultaneously by

representatives of the company and by one of the board and the assistants to the board.

Hand-picked Pocahontas coal of excellent quality was used in all of the tests.

PRINCIPAL RESULTS.

On test No. 1, burning 15 pounds per square foot of grate per hour, the rate of evaporation from and at 212 degrees F. per pound of combustible was 12.15 pounds of steam. The blower was not run and the boiler compartment was open. The weather was warm and clear.

On test No. 2, burning 25 pounds, the evaporation was 12.07 pounds. The steam jet in the stack was partly open, and the blower was run to ventilate the fire room, but the compartment was open. The weather was clear.

On test No. 3, burning 35 pounds, the evaporation was 11.77 pounds. The steam jet was partly open, the forced-draft blower was run and the compartment was closed. The weather during this test was cloudy and rainy.

On test No. 4, burning 40 pounds, the evaporation was 11.89 pounds. The forced-draft blower was in operation and the compartment was closed. The weather was rainy during the first half of the test, then clear.

The evaporation for all these tests is figured from and at 212 degrees F., and is based on pound of combustible.

During test No. 5, at the maximum capacity, or at about 70 pounds per square foot, the temperature of the water in the boiler was 102 degrees, the furnace was primed and fires lighted at 9:04 A. M.; steam formed at 9:12 A. M.; steam pressure 100 pounds at 9:18.92 A. M.; 200 pounds at 9:19.75 A. M. The steam jet was wide open on the smokestack and the forced-draft blower working giving a pressure of about 3½ inches of water in boiler room. The rate of evaporation from and at 212 degrees F. per pound of combustible was 10.33 pounds.

On test No. 6, burning 45 pounds coal per square foot of grate, the evaporation from and at 212 degrees F. was 11.3 pounds.

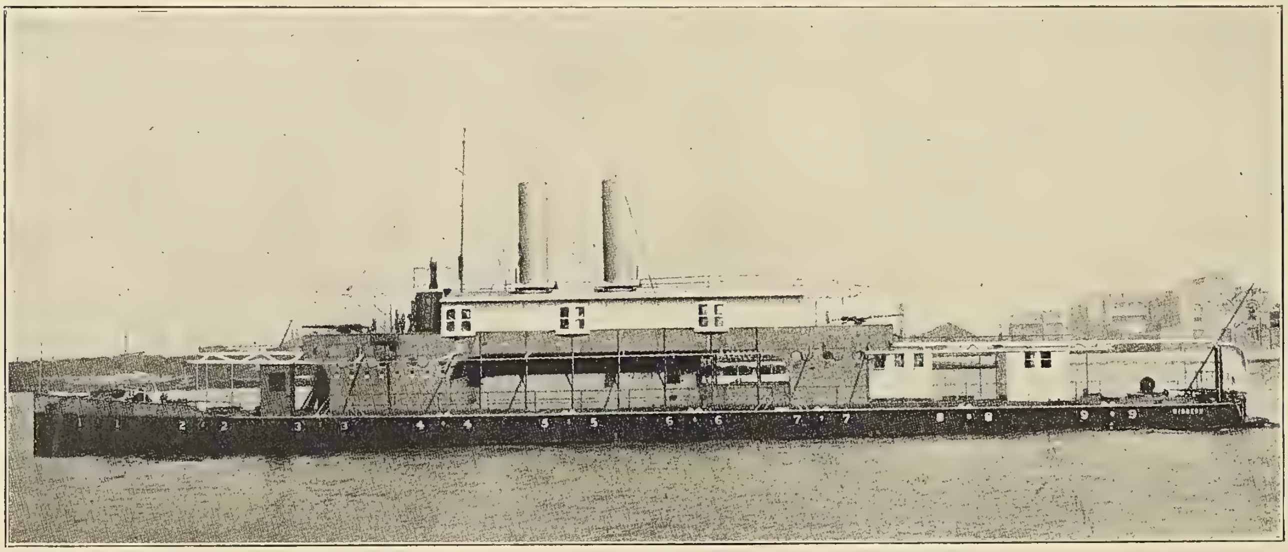
The coal used in test No. 4 analyzed as follows:

Moisture, 1.06 percent	dry
Volatile matter, 20.96 percent	21.18 percent
Fixed carbon, 74.83 percent	75.63 percent
Ash, 3.15 percent	3.19 percent
Sulphur, 0.7 percent	0.71 percent
Heat value, 15,225 B. T. U.	15,388 B. T. U.

Upon the completion of the tests the boiler was examined and found in good condition.

SHALLOW-DRAFT GUN BOAT WIDGEON.

The shallow-draft gunboat *Widgeon,* built for the British Admiralty by Messrs. Yarrow & Company, Glasgow, comprises two features which are unique with the builders. In the first place, she is a screw-propelled boat, having the propeller installed in a tunnel fitted with Yarrow's patent hinged flap for regulating the efficiency of propulsion according to the conditions of load. Second, the boat was built in sections, each section being flotable, so that the various sections could be united while afloat after having been shipped to their destination. This system of construction eliminates the necessity of erecting the boat on shore and of launching it. The construction of shallow-draft boats in flotable sections was first introduced by Messrs. Yarrow & Company in *Le Stanley,* built for His Majesty the King of the Belgians for the use of the late Sir H. M. Stanley on his journey up the Congo in 1883, and has since been extensively adopted in boats of this type.



TWIN-SCREW, SHALLOW-DRAFT GUNBOAT BUILT IN FLOATABLE SECTIONS.

The *Widgeon* is 160 feet long with a beam of 24 feet 6 inches. The steel work of the hull is galvanized throughout, the officers' quarters are on the main deck and the crew's quarters on the battery deck. Above the battery deck is a teak sun deck with double awnings. The sides of the machinery space, magazines, officers' quarters, battery deck and conning tower are all protected by bullet-proof steel plates, those around the cabins being loop-holed for rifles. The armament consists of two 6-pounder quick-firing guns and four rifle caliber Maxims. The draft of the vessel complete, when carrying a load of 40 tons, is less than 29 inches.

The machinery consists of compound engines and Yarrow watertube boilers. The boilers are fitted for burning either wood or coal, and on the trial trip, when a mean speed of 13.15 knots at 283.4 revolutions per minute was obtained, the fuel consumption proved to be 8 pounds of wood per indicated horsepower per hour.

Trials made to ascertain the effect of the patent movable flap over the tunnel showed that the horsepower with the flap raised and with the flap lowered was practically constant, but that the slip when the flap was down was augmented about 25 percent.

NOTES ON THE ARMAMENTS OF BATTLESHIPS.*

BY SIR WILLIAM H. WHITE, K. C. B., F. R. S., D. SC., D. ENG., LL. D.

One fundamental idea has governed the armaments of warships in all ages: viz., the desire to provide means of offense which will enable a ship making an attack to put her enemy "out of action" in the shortest possible time and ensure the least possible damage to the attacking ship during the conflict. Until armor was first used for defensive purposes, about half a century ago, there was universal agreement with the doctrine that "an active and powerful offense constituted the best means of defense." Since that date this doctrine has been somewhat obscured, no doubt, by the attention devoted to improved methods of manufacturing armor, to rival systems of distributing protective materials; by the never-ending struggle between the attack and the defense—guns and armor—and by the development of under-water attacks—locomotive torpedoes and torpedo vessels, submarine mines and submarines. It may be admitted also that, under modern conditions, an active offense is no longer the only means of defense; but, on the other side, it cannot be denied that an active offense is still and always must continue to be the best means of defense. It gives the greatest assurance of victory —in other words the greatest probability of putting an enemy "out of action."

This old phrase continually occurs in descriptions of naval battles of the past; and it is no less applicable under modern conditions than it was in the days of sailing ships and smooth-bore guns, or even in that remoter period when naval warfare was carried on by galleys propelled by oars and manned by soldiers. Victory never has depended and never will depend entirely upon the destruction or capture of an enemy's ships, but upon their being brought into a condition of incapacity to continue the struggle—that is to say, being put out of action. That result may be attained in many ways, but it must be reached in some way before victory is secured. All naval history confirms this statement; it is, in short, a truism. Looking back upon the great wars of the eighteenth and beginning of the nineteenth century it is seen that ships were put out of action by the destruction of or serious damage to their means of propulsion, to their mobility and maneuvering power; by being set on fire; by slaughter of their crews; by loss of morale; by panic arising from accident or damage which prevented continued utilization of existing means of offense; by overpowering or seriously injuring the armaments, and in other ways that need not be particularized.

This statement of the case applies primarily to circumstances affecting individual ships, and it designedly omits reference to the supreme influence which naval tactics may exercise upon the result of a fleet action, or to the skill of a commander in concentrating upon a portion of the enemy's fleet an overwhelming attack. When the tactician has done his best, it still remains true that the chief aim in a naval engagement must be to put an enemy's ships "out of action" as quickly as possible, and that sinking or destruction of ships is not necessary to secure that result, although it may be an accompaniment of victory.

From the point of view of this paper, the question to be considered may be stated, therefore, as follows: What description of armament is likely to prove most effective for speedily putting out of action modern battleships, having regard to existing materials of construction, structural arrangements, armor defense, means of propulsion and maneuvering; as well as to the characteristic qualities of guns, projectiles, explosives, torpedoes and mines now available for use? In considering this question it will be assumed that, in addressing this society, there is no need to recapitulate the remarkable advances which have been made in all these features of war-ship construction during the last half century. The facts are on record, and the existing situation is well known to members.

Certain features of the problem may also be assumed to lie outside the field of discussion. It is generally agreed that future naval actions will probably be fought at longer ranges than have been adopted in the past. The main reasons for this increase in fighting range are to be found, on one side, in the development of locomotive torpedoes and the increase of their speed, accuracy and effective range; while on the other side stand no less important improvements in naval gunnery—including guns, propellants, projeciles, explosives, range-finders, sights and means of control. Nor can there be any dispute as to the fact that increase in gun-caliber in association with a constant muzzle velocity secures greater flatness of trajectory, and greater accuracy of fire, as well as superior maintenance of energy at long ranges. But when general statements of this nature are closely examined differences of opinion on practical matters are found to exist among men equally entitled to a respectful hearing, and these differences sensibly influence their choice of armaments.

LONG FIGHTING RANGE AND SECONDARY ARMAMENTS.

In regard to the probable fighting range for future naval actions there are marked differences of opinion. While all agree that it is likely to be greater than heretofore, two distinct schools of thought exist as to the minimum range likely to occur in practice. One of these asserts that an extremely long range will be chosen and maintained by commanders whose fleets possess greater speed and whose ships are armed on the "single-caliber, big-gun" principle; and it is argued that at this great range vessels so armed will be able speedily to put out of action an enemy's ships which individually carry fewer big guns, although these may also possess powerful and well-protected secondary armaments. These secondary armaments, it is urged, would be of no practical service at very long range; because of an alleged inferior accuracy (due to more curved trajectories traversed by their relatively small and light projectiles), their proportionately greater loss of energy as ranges increase, and their presumed ineffectiveness because of their lack of power to penetrate armor of moderate thickness, their alleged less proportion of hits to rounds fired, and the small bursting charges carried by their shells.

The other school maintains that, although actions may be begun at very long ranges on occasions when atmospheric conditions are favorable, average conditions of weather at sea will not favor that kind of attack nor make its results decisive. They give reasons for the belief that when an issue is joined, with the full intention to reach a decisive finish, it is practically certain that closer ranges will be reached; and they insist that the choice of armaments ought not to be governed by a set of assumptions which relate exclusively to extreme ranges and are subject to the continued efficiency of comparatively delicate sights and range-finders as well as apparatus for controlling gun-fire. In their judgment it is desirable to associate with big guns a powerful secondary armament of quick-firing guns, adequately protected and so placed as to be efficient both in horizontal command and in height above water, while free from interference arising from independent firing of heavy guns.

In support of this advocacy of good secondary armaments it is stated that modern types of battleships, including those on which armor defense has been most developed, still contain many vulnerable points, injury to which will seriously

* A paper read before the Society of Naval Architects and Marine Engineers, New York, November, 1910.

interfere with the fighting, maneuvering and steaming capability, the transmission of orders from conning-towers and control stations, signaling and other operations which considerably influence fighting efficiency. It is noted that more than one-half of the length of heavy guns is permanently exposed and unprotected. Cases have occurred in action where these unprotected portions have been injured, the heavy guns having been put out of action by the fire of light guns which were impotent at the fighting range against armor of moderate thickness. It is also maintained that the small height above water to which the hull armor rises, and the large unarmored areas of the sides above water, must involve serious risks to a considerable number of recent battleships should they be subjected to attack by a large number of 6-inch quick-firing guns using high-explosive bursters and common shell. The "volume of fire" obtainable from such quick-firing guns would, it is considered, inflict great damage to the thin steel-plating above the armor, and so permit considerable quantities of water to find access to the interior of the ship above the protective deck, although the hull armor was left intact. Such an entry of water might seriously prejudice stability or produce objectionable "list" and change of trim, even if it did not pass below the protective deck; but there would also be the danger of large quantities of water finding its way into hold spaces and there accumulating.

These anticipations of trouble, of consequent reduction of stability, loss of maneuvering power, diminished speed and lessened mobility, are treated by the other side as unlikely of fulfilment. In support of this view it is urged that, although at short or moderate ranges the 6-inch gun makes good practice and scores a high percentage of hits to rounds fired in comparison with the percentage attained by larger guns, yet at long ranges the percentage of hits to rounds becomes comparitively small. Consequently it is considered that injuries of the kind assumed to be produced by the fire of secondary armaments are not likely to be either serious or extensive. There is obviously room for difference of opinion in regard to such matters and the proper method is to trust to experience when attempting to reach a decision. When tested on a proof ground, with guns and targets fixed and ranges known, the percentage of hits to rounds fired will undoubtedly become greater at long range as the caliber of guns is increased. These conditions, of course, do not represent those which would occur in a sea fight, between fleets or between single ships, moving rapidly in relation to one another, and commonly in circumstances which will be accompanied by rolling or pitching of the gun platforms. It is not possible in peace time to imitate all the conditions of war; in particular the disturbing influences which necessarily arise when a war-ship is fired at by an enemy while making an attack cannot be represented. But there is in existence a considerable body of information based upon "battle-practice" at long ranges. These facts have not been published in detail nor are they likely to be. The writer has, however, been assured by naval officers of great experience possessing full and accurate information of this kind, who have carefully analysed results of firing at very long ranges, that the percentage of hits to rounds fired obtained with 6-inch guns under service conditions at sea compares favorably with and is not inferior to the percentages obtained with guns of larger caliber. Furthermore he has good reason for the belief that actual trials do not confirm the objection raised to "mixed" armaments on the ground that the simultaneous discharge of guns of different calibers must be accompanied by diminished efficiency in the control of fire and in the proportion of hits to rounds made by guns of different calibers. If these conclusions be true—and the writer is convinced that they are so—then it is unquestionable that even at long ranges the secondary armaments of battleships will be capable of delivering a "hail of fire" against an enemy and of exercising an important influence on the result of an action.

Published accounts of naval engagements during the Russo-Japanese War also emphasize the importance attaching to attacks made by efficient and well-handled secondary armaments carried by Japanese ships. It is probable that the deep-laden condition of Russian ships at Toushima tended to increase sensibly the prejudicial effects of fire from the lighter guns of the Japanese fleet; but after making full allowance for this feature it appears proven that considerable danger must always attend the extensive damage to unarmored superstructures which quick-firing guns of moderate caliber can inflict even at long range. What the "volume of fire" from such guns involves in damage done to signaling apparatus, control appliances and the general working of a ship in action, Captain Semenoff has graphically described. What it may do in making ships unmanageable or in temporarily destroying the command of maneuvering capability was demonstrated at Toushima and in the battle of August 10, 1904, off Port Arthur. Under the terrible hail of projectiles and of fragments of shells containing high explosives it has happened, and will happen again, that a "joint in the harness" is discovered and the ancient story of the "bow drawn at a venture" is repeated. The Japanese authorities, who may be supposed to have all the facts of the war in their possession, and who are certainly capable of analysing them, and drawing therefrom lessons for guidance in future practice, have never departed from the use of powerful secondary armaments. Personal conferences with leading Japanese authorities on naval matters enable me to say that they attach the utmost importance to the association of such armaments with guns of large caliber. In fact the trend of naval opinion throughout the world during recent years has been against the perpetuation of the system which discarded all guns except those of large caliber and 3-inch guns for use against the attacks of torpedo vessels. Consequently there is a danger of appearing "to flog a dead horse" by further advocacy of secondary armaments on this occasion, and no more need be said thereupon.

As to the most suitable numbers and calibers of guns making up the secondary armaments of modern battleships little need be added. There are obvious objections to the employment of many calibers, each requiring special ammunition and making separate control desirable. In some ships guns of 6-inch, 4.7-inch, 3-inch and smaller calibers have been mounted. Such a multiplication of calibers appears both unnecessary and objectionable. Probably the explanation is to be found in an intention to use guns from 4.7-inch downwards as an active defense against the attacks of torpedo vessels, and to supply 6-inch guns as auxiliaries to the 12-inch guns in action. The writer has long advocated a simpler arrangement which, in his judgment, would fulfil all requirements, and ventures to quote remarks on this head made at the Institution of Naval Architects a few months ago:

"The ideal armament, to my mind, is that which embodies a certain and not an extravagant number of heavy guns associated with a considerable battery of 6-inch guns. It does not seem to me a difficult matter to supply these 6-inch guns with ammunition which shall be efficient when used against attacking torpedo vessels. If anything in addition to such a secondary armament of 6-inch guns is wanted I should say "man-killing" guns capable of very rapid fire might be used for sweeping the decks of torpedo vessels; they could be placed and fought in almost any position and would require only shield protection."

Twenty-six years ago the writer, in conjunction with the late Lord Armstrong, worked out a design for a vessel in which ammunition of the special kind mentioned was provided for guns of 5-inch to 6-inch caliber for use against torpedo

craft. It has been reported recently that experiments have been made with shrapnel fired from 12-inch guns as a possible means of repelling torpedo attacks. If this be true the principle advocated has been carried to an extreme which will not commend itself generally, but the experiments constitute a virtual confession that 3-inch guns are not sufficiently powerful to deal effectively with modern torpedo vessels. That view of the matter has been confirmed by the adoption of 4-inch and 4.7-inch guns instead of 3-inch in ships of recent design; while 6-inch guns are now commended for defense against torpedo vessels in quarters where 3-inch guns were advocated four or five years ago as the only auxiliary armament required. The compass has been "boxed" in a very short time, and without any war experience to justify the change of opinion.

The main reason for preferring a caliber of about 6 inches is that experience proves projectiles of about 100 pounds weight to be the maximum which can be "man-handled" continuously and rapidly; while accuracy of fire even at long range can be combined with rapidity of discharge and remarkable effectiveness against the lightly armored, unarmored and vulnerable points of war-ships. Personally, I have always maintained the view that these quick-firing guns, their crews and the supplies of ammunition should have a remarkable amount of armor protection against the fire of similar guns carried by an enemy. In designs for which I was responsible more than twenty years ago, in which the earliest 6-inch quick-firing guns were mounted, such protection was provided. Nothing that has since occurred has shaken that conviction, and my opinion remains fixed that the secondary armament should be not merely available for use in repelling torpedo attacks but should be used in battle and be regarded as a valuable auxiliary to the heavy guns. The disposition of the 6-inch guns should be of a character that will effectively fulfil both these functions. It is not difficult to secure that result in designing war-ships, and to place the 6-inch guns so that they shall not be hampered or interfered with by the fire of the heavy guns, provided that the number of the heavy guns carried in a ship is not made excessive.

THE NUMBER OF HEAVY GUNS TO BE MOUNTED.

Turning to the consideration of what constitutes a reasonable number of heavy guns for the principal armament of a modern battleship, it will suffice on this occasion to restate the writer's conclusions and to briefly summarize the reasons therefor. These conclusions are admittedly open to debate and other views may be maintained on the basis of solid argument. The case is necessarily one for compromise, and therefore for difference of opinion as to the best course to be pursued.

There are two positions for heavy guns which, by common consent, confer supreme advantages and are always utilized. These positions are at the center line of the deck; one commanding right-ahead fire, with large arcs of horizontal training reaching well abaft the beam on each side; the other possessing corresponding command right astern and over large arcs of training reaching well before the beam. Until the Michigan and South Carolina were designed it was the general practice to mount one or two heavy guns—two in nearly all cases—in each of these positions. Superposed turrets were tried in some cases, and 8-inch guns were mounted in the upper emplacement; but this practice did not find much favor and may be considered to have dropped out of use. It was a new and bold departure in the Michigan and South Carolina to place two turrets in each of the supreme positions, and to arrange for firing the guns in one turret over the top of the other turret. That arrangement proved successful, however, and has been largely adopted in recent ships of all navies. When associated with the mounting of guns in pairs this system permits the effective use of eight heavy guns; if three guns are mounted in each turret then twelve heavy guns can be given equal arcs of command, and all the guns can be used on each broadside.

The writer has always favored and still favors the system of mounting heavy guns in pairs. French designers long preferred separate mountings for single heavy guns, and placed two gun stations amidships—one on each side. The French system was tried in the British armored cruisers *Imperieuse* and *Warspite*, and, as the result of trials, it was not repeated; the French themselves subsequently abandoned the arrangement. Twin-mountings were universally employed for a long period, and, in the writer's judgment, that plan embodies a reasonable compromise. Considerable economy is thus effected in the weight of the mountings and armor protection for a pair of heavy guns, as compared with what is needed with separate mountings for each gun; and although the risk of simultaneous disablement of two guns is necessarily incurred when they are carried on a single turntable and within the same armored station, that does not seem to be an undue risk. When three guns are mounted on one turntable and exposed to similar risks of simultaneous disablement then, in the writer's judgment, too many "hostages are given to fortune," and economy in weight of protective material and mountings has been carried too far. Actual trial will determine whether or not it is possible to maintain the same rapidity in loading and firing individual guns in a triple turret as can be obtained when two guns are mounted in one turret, and Italian naval authorities before deciding in favor of triple turrets probably satisfied themselves on this point. Italy has made many successful new departures in war-ship design, and will work out this problem thoroughly. The results will have great interest for all engaged in war-ship construction; but even if they prove satisfactory under peace conditions and as to rate of fire, only war experience can determine the crucial point as to the risk of simultaneous disablement of three guns mounted on a single turntable. The approximate allowance hitherto made for triple as compared with twin turrets is understood not to exceed an increase in diameter of about 10 percent, in some cases has been less. Obviously it would be reasonable in triple turrets to make provision for stronger armor protection and for ampler margins of strength in machinery and structure in order to meet special risks, and to render the possibility of disablement more remote. If this were done the relative weights involved in the triple as compared with the twin arrangement would be considerably increased.

In passing, one may remark that there is always a danger lest the desire to keep down weights of protective materials on heavy-gun stations should lead designers to accept relatively weakened structures and supports to armor and smaller clearances between fixed structures and revolving parts than would afford reasonable provision for safety and for continued efficiency in working when heavy blows are delivered, in action, upon the armor forming barbettes, shields or turrets. This feature in design has always received close attention in my own practice; and the dimensions and weights of structures, armor and mechanisms have not been reduced, nor have any known or probable risks been accepted, in order to minimize weight. Having regard to the vital importance of the continued efficiency of heavy gun armaments, and to the enormous weights and cost involved in installing and protecting such armaments even when dimensions are minimized, it seems preferable to err on the side of large margins of safety than to seek the irreducible minimum—the determination of which is not an easy matter, even for those most fully informed as to the results of peace experiments and past naval actions.

For over twenty years the heavy guns of most battleships

continued to be four in number, and in nearly all cases they were mounted in pairs on the center line of the deck at the two important positions above described. In connection with the introduction of the latest types of battleships—usually described as "Dreadnoughts"—a necessity arose for finding other positions for heavy guns. Ten or twelve such guns have been usually thought desirable; thirteen guns are to be carried in ships now building. Consequently three or four additional gun stations have had to be provided, and large hold spaces have been devoted to the stowage and supply of ammunition immediately below each turret. Different dispositions of heavy-gun stations have found favor, not merely in different navies, but in successive ships of the same navy. In these circumstances it becomes obvious that no fixed principles have been established or generally followed hitherto in disposing heavy-gun armaments. It is unnecessary to describe in detail various arrangements adopted in recent ships, because they are well known to members of this society; but mention may be made of certain salient features which illustrate the diversity of views that have prevailed.

In many cases history has been repeating itself; arguments which were familiar thirty or forty years ago have reappeared and have been treated as novelties. Widely differing estimates have been formed in regard to the relative importance attaching to "end-on" and broadside fire. In the earlier French disposition—in which two heavy guns were mounted forward and aft on the center line of the deck as bow and stern chasers, and two others in positions on each broadside (nearly amidships) which enabled them to be fired directly ahead or astern—"end-on" fire was treated as of equal importance with broadside fire. Three guns were available on each broadside and three guns could be fired either ahead or astern. In ships of the "central-citadel" type (designed about 1873-1878) four heavy guns were carried in two turrets which were placed *en echelon* nearly amidships, and it was possible to fire all four guns parallel to the keel, either ahead or astern. Each pair of guns had 180 degrees of training on the broadside whereon they were placed, but on the other broadside these guns had only a very limited arc of training. In these vessels, therefore, "end-on" fire was theoretically superior to broadside fire. Experience showed, however, that superstructures erected above the upper decks—primarily to limit the effect of "blast," when the guns were fired parallel to the keel-line or at large arcs of training from the beam—imposed serious limitations and disadvantages against a moving target placed nearly ahead or astern. The echelon disposition was, therefore, abandoned and a return was made to the earlier plan which mounted four guns in two commanding positions forward and aft on the middle line of the deck.

During the last five years we have seen both the old French disposition and the echelon arrangement reproduced (in principle) in new designs, only to be abandoned in later designs, in some cases before practical experience had been gained with the arrangement which was abandoned. Now there is a marked disposition to place all the heavy-gun stations at the center line of the deck, so that all the guns may be available on both broadsides. This is a return to a disposition adopted in the earliest British turret ships built nearly half a century ago. The *Royal Sovereign* (1862) and the *Prince Albert* which followed immediately after her each had four turrets so placed. It may be noted that the United States navy took the lead in this last movement, and further has the credit of demonstrating the possibility of associating powerful bow and stern fire with the maximum of broadside fire over large arcs of training, by placing some turrets higher than others and firing over the lower turrets on certain bearings.

"END-ON" AND BROADSIDE FIRE.

Advocates of "end-on" fire assert that an attacking ship which is end-on to an enemy presents to her fire a target of which the projected area (on a vertical plane) has, for its largest dimension, the extreme breadth of the ship and for its height the height of her uppermost deck; so that the chance of hitting effectively is diminished greatly as compared with broadside attack. This statement overlooks important conditions, and is therefore misleading. A ship attacking end-on must present to the fire of an enemy a horizontal target of which the greatest dimensions are the full length of the vessel, and (transversely) her extreme breadth. Consequently, errors in elevation of guns which the enemy may make are less likely to result in missing this long horizontal target than would be the case if corresponding errors were made when firing at a target of which the greatest dimension was the extreme breadth of a ship lying broadside on to the line of fire. No one can deny that the minimum of defense of vital parts of battleships—especially against "dropping" fire at long ranges—is to be found in the resistance offered by protective-deck plating, and not in the strength of vertical side armor. Nor can it be doubted that even in single-ship actions it would hardly be possible for a combatant to maintain for long the assumed "end-on" position; while in fleet actions no commander could possibly effect a similar object with a large number of ships by any conceivable tactics, if engaged against a skilful and mobile enemy. If a choice has to be made, therefore, between highly developed broadside and end-on fire it seems reasonable to give precedence to the former. This has been done in the majority of recent battleships; but it is also reasonable—having regard to great and rapid variations unavoidably occurring in the relative bearings of ships in action—to develop end-on fire to a reasonable extent. The compromise represented in the *Michigan* class now secures wider acceptance and is likely to become more generally adopted.

No difference of opinion exists as to the necessity for giving the largest possible arcs of horizontal command to the fire of heavy guns, so that in action they may be kept bearing on an enemy for the longest attainable periods as his relative position rapidly changes. When this principle is applied in working out the disposition of guns for a new war-ship one soon encounters numerous as well as serious limitations and finds that the difficulties in securing large arcs of training increase with increase in the number of gun stations. In many cases the attempt to mount a large number of guns and to give to each gun considerable arcs of training has involved serious risks of injury being inflicted on neighboring guns and their crews, when fire is delivered at or near the extremes of assumed arcs of training. Attempts are made, of course, to minimize or to prevent such risk of injury; but so-called "safety appliances" are usually of a delicate and elaborate nature and not unfrequently are intended to be automatic in action. One may be permitted to doubt whether, in the heat of action, these appliances will always fulfil their intended purpose; and it appears desirable when arranging armaments to secure practical non-interference of gun with gun, even if that course involves a decrease in the number of heavy guns mounted in a ship of given dimensions, or an increase in the dimensions of ships intended to carry a given number of guns.

In discussions of war-ship designs the relative merits are commonly assessed on the basis of what has been accomplished on particular dimensions and displacement. That method of comparison may be and often is carried to unreasonable lengths, no account being taken of the drawbacks and dangers involved in cramming many guns into ships. Freedom of action for each gun-crew, and a sense of security from interference arising from the fire of adjacent guns, are essential factors in the estimation of real fighting efficiency, even in days when the control of gun-fire from central stations is so much in vogue. Statistical statements may give to a ship so many guns and certain assumed arcs of command; but it

is necessary to consider thoroughly what would happen if these guns were fired at their assumed extreme arcs of training before a true estimate can be formed of the efficiency of an armament. The limits of really safe training are often found in practice to be considerably less than the extremes embodied in published descriptions, and the results of firing trials cause narrower limits of training to be accepted. No good purpose is served when large arcs of command exist only "on paper," and their utilization in action would involve serious risks to the structure, armament or personnel of the ships in which the guns are mounted.

OBJECTIONS TO LARGE NUMBERS OF HEAVY GUNS.

One is led to inquire, in present circumstances, whether it is possible to discover a reasonable basis for fixing the maximum number of heavy guns which should be carried by a battleship. It has been previously stated that the number of heavy guns actually carried in ships built since 1905 varies from eight to thirteen per ship, ten or twelve being carried by most ships, and the stations varying from four to six. Although it is not possible to lay down hard-and-fast rules, or to reach any general agreement, certain considerations may be mentioned which must be kept in view by all designers of war-ships. For instance, whenever heavy guns are mounted in positions near the middle of the length of a ship it is unavoidable that spaces shall be found for the installation of the magazines, shell rooms, ammunition supplies and gun-working machinery in a region mainly appropriated to the propelling apparatus and stowage of fuel. This juxtaposition of features essential to the efficiency of the principal armament and of those upon which efficiency of propulsion depend, involves considerable difficulties upon which one need not dwell. Experience on a large scale proves the need for special precautions in order that magazines may be kept cool and deterioration of the ammunition prevented; in not a few instances these magazine spaces make difficult the communications between compartments of the hold occupied by the propelling apparatus, or interfere with the efficient control and working thereof; while the arrangements for transporting coal from the bunkers to the stokeholds are rendered inferior in efficiency to those which exist in ships wherein the spaces assigned to engines, boilers, bunkers, are not broken up by magazines and shell rooms. It is also admitted that in ships which have five or six heavy-gun stations, the deck arrangements, the stowage and handling of boats and other matters incidental to every-day work and general convenience are all less satisfactory and convenient than are the corresponding features in ships where no heavy guns are mounted in the central portions of the length. In the last-mentioned vessels less difficulty is experienced in dealing with magazine temperatures, or in arranging for powerful secondary armaments, which shall be thoroughly efficient and practically free from risk of interference being caused by the fire of the heavy guns. It may be argued that these inconveniences and objections are relatively unimportant, that they have been and can be overcome sufficiently for practical purposes, and that they must be accepted in order to obtain the essential quality of a preponderating offensive power. Even if this be granted, it still remains a matter for debate whether, on the whole, it is desirable to mount ten or twelve heavy guns in five or six positions in any single ship.

The main reason advanced in favor of mounting ten to twelve guns in a battleship is that, in this manner, an overwhelming concentration of offensive power is secured. It has been the fashion in some quarters to adopt the simple method of assessing offensive power by counting the number of 12-inch guns carried. A ship carrying, say, twelve 12-inch guns has been reckoned equal to three ships each armed with four 12-inch guns even when the latter have carried in addition powerful and well-protected secondary armaments. It hardly seems necessary to deal with such a method of comparison in this paper and before this society, and it will be more profitable to state certain governing conditions to which regard must be had in reaching a reasonable conclusion on the point now under consideration.

No one questions the importance attaching to a highly concentrated attack on an enemy; but it is equally certain that, in present circumstances—as naval actions will be fought at very long range—the fire of twelve 12-inch guns carried by three ships can be as effectively concentrated on any selected point in an enemy's formation as it can be when the guns are mounted in one ship. Again, three ships armed on the *Michigan* plan could concentrate the fire of twenty-four 12-inch guns as efficiently on a selected position in the enemy's formation as could be done by two ships of the *Arkansas* class with an equal number of guns. Indeed under certain conditions the three ships might have an advantage and be capable of keeping all their guns bearing on an enemy in rapid motion longer than could be done with all the guns in the two ships; because the provision of six stations instead of four in the latter necessarily introduces greater limitations of the effective arcs of command of some of the guns than are imposed on eight guns mounted as in the *Michigan*. This latter consideration no doubt has had much to do with recent advocacy of larger calibers than 12-inch for battleships, because it is realized that the multiplication of positions and guns in a single ship is accompanied by increased interference and possibly with diminished efficiency of fire control.

That multiplication of gun positions has been necessarily accompanied by considerable increase in the length of battleships even when the protection and speeds have remained practically unchanged. As a contrast we may take the *Arkansas* with a length of 545 feet and twelve 12-inch guns as compared with the *Florida* of 510 feet in length with ten 12-inch guns. It is true, of course, that increase of speed has even greater influence on dimensions and especially on length; but it is certainly remarkable to note the construction of armored ships which are about 700 feet in length and yet carry only eight heavy guns in four positions (13.5-inch caliber) whereas only five years ago ships about 200 feet shorter carried ten heavy guns (12-inch) in five positions, and others about 250 feet shorter carried twelve heavy guns (11-inch) in six positions. Such additions to length may not be considered objectionable on the ground of diminished maneuvering power, in view of the facts that in future long-range fighting will be the fashion, that by various devices their handiness has been increased in proportion to their dimensions. On the other hand, it appears obvious that when associated in fleets vessels of this great length and high speed will require for safe handling an increase in the intervals between successive ships, so that the length of the line in proportion to the number of ships comprising it will have to be sensibly enlarged. Nor can it be disputed that this great increase in length renders greater the danger of damage from torpedo attack, even when it is recognized that with such vessels, although the commander of a fleet may intend to keep outside torpedo range, yet in action that intention may not be realized.

Under-water attacks by torpedoes, by submarines and by mines are undoubtedly among the greatest dangers to which modern war-ships are exposed, although the gun still remains the supreme weapon of offense. It is agreed that a single successful blow struck by a modern torpedo will probably produce damage which will put even the largest ship "out of action," although she may not be sunk. On this ground, therefore, it may be maintained that a limit ought to be put upon the concentration of gun armaments upon single ships, and upon the increase in dimensions and costs of individual ships; because one successful blow may, by general consent,

bring about such a serious proportionate loss to a fleet by injury to one vessel and her compulsory withdrawal from action. Moreover, many services are required from a fleet in the performance of which capacity for distributing the force is no less important than the power of concentrating it for an attack. From this point of view unlimited increase in dimensions, cost and individual power of battleships is not desirable. As to the assertion that increased steadiness of ships, considered as gun platforms, necessarily proceeds *pari passu* with increased dimensions, it need only be said that experience has proved the doctrine to be fallacious. Battleships of the modern type carrying numerous heavy guns high above water, and protected by great weights of armor, must be endowed with considerable initial stability in order to possess sufficient range of stability. As a consequence they have proportionately shorter periods of oscillation, as well as lessened steadiness under unfavorable conditions of sea. It is a matter of common knowledge also that some of the steadiest war-ships ever built have been vessels which were of small dimensions when judged by present standards. This feature in behavior, of course, is distinct from the power of maintaining speed in a sea-way; that quality is undoubtedly favored by increase in length and weight.

No claim is made that new statements of the case have been embodied in the foregoing summary of points in favor of or adverse to the adoption of battleship armaments comprising a large number of heavy guns in each vessel. All that has been attempted is to bring such points into view, fairly and briefly. Having done so the writer desires to place on record his personal opinion that in no case is it desirable to carry more than eight heavy guns in a single ship, that these guns are best arranged in four positions as in the *Michigan* class, and that they should be supplemented by a powerful and well-protected secondary armament.

INCREASE IN CALIBER OF NAVAL GUNS.

Allusion has been made to the movement now in progress for using guns of larger caliber in battleships and armored cruisers. In the United States the 14-inch gun has found favor; in Great Britain the 13.5-inch has been reintroduced; in Germany the 12-inch has been adopted instead of 11-inch. The reasons given for this departure from long-established usage may be summarized as follows:

1. With larger calibers it becomes possible to reduce muzzle velocity and to diminish erosion in the interior of guns, and yet to secure ample penetrating power against armor and superior maintenance of energy at long ranges.

2. A flatter trajectory and increased accuracy at long ranges can be obtained with guns of larger caliber.

3. Increased capacity of bursting charges can also be secured for all descriptions of shells.

4. If it be assumed that a certain total striking energy and a certain total shell-burster effect are to be obtained by one discharge of all the heavy guns mounted in a ship, then it is possible to diminish the number of guns carried if the calibers are increased, and to obtain more efficient control of fire.

All these arguments in favor of larger guns are, in principle, identical with those employed more than thirty years ago, when increase in the weights and calibers of naval guns was made with great rapidity. The arguments then prevailed for a time; and history is, in this particular, now repeating itself. At that period in the British navy we passed from 12-inch breech-loading guns weighing 45 tons and firing projectiles of 714 pounds to 13.5-inch guns weighing 67 tons and firing 1,250-pound projectiles, ending with guns of 16.25 inches caliber weighing 110 tons and firing 1,800-pound projectiles. Within a few years experience then induced a return to 12-inch guns and for a long period no larger caliber was used, but great and continuous improvements were made in guns, projectiles and explosives. Behind the reversion to more moderate calibers stood the conviction, based on actual usage and experiment, that the 12-inch caliber was sufficiently large for all practical purposes, whether armor-perforation or shell-power was considered; and that, on the whole, for a given expenditure of weight on the principal gun armament of a battleship the 12-inch gun furnished the best combination of adequate numbers and individual power. It has been stated recently that the chief reasons for abandoning the larger calibers were to be found in the difficulty encountered in making such guns or in loading and working them. As one who was intimately concerned with the matter the writer denies that these were the real causes of return to the 12-inch caliber. The subject was fully discussed by the Admiralty in 1888, when the designs for battleships of the *Royal Sovereign* class were under consideration, and it was then decided to make the change as soon as possible; but no satisfactory design for 12-inch guns was then available and consequently the 13.5-inch caliber was used once more. At the same time action was taken to obtain a new and satisfactory design of 12-inch gun, and as soon as it was available it was adopted in the *Majestic* class (1892).

Twelve-inch guns of the latest design are much more powerful weapons than their predecessors of twenty years ago; their projectiles are capable of penetrating at very long ranges the thickest hull armor fitted on the side of existing battleships. As regards armor perforation it is generally admitted that no increase in caliber is required. Although their trajectories may not be so flat as those of larger guns, practice made at sea with 12-inch guns at very long ranges is undoubtedly excellent. For the same approximate total weights of guns, ammunition, gun-mountings and mechanisms, and protecting armor it is possible to provide for five pairs of 12-inch guns as against four pairs of 13.5-inch guns. In other words, if equal rapidity of fire is assumed to be obtained by guns of the two calibers, for each ten rounds delivered by the 12-inch guns only eight rounds would be delivered from the 13.5-inch. It is improbable that in actual service equal rapidity of fire would be long maintained by the larger guns; but in any case the unavoidable uncertainties attaching to naval gunnery make the larger number of rounds fired and of hits made by the 12-inch guns a most important feature in the comparison of their efficiency with that of larger guns. For attack on the armored portions of modern battleships (as already remarked) blows from the 12-inch guns are admittedly heavy enough so that they would have a distinct advantage in this respect. In regard to shell fire, trials made against the French battleship *Jena* and against several British ironclads demonstrate conclusively that shell fire from 12-inch guns can rapidly destroy unarmored portions of battleships and can inflict great damage on the armored portions and on protective decks, provided projectiles of suitable design are used. The larger bursters possible with 13.5-inch shell—say about 40 percent greater in weight than the bursters of 12-inch shells—will undoubtedly inflict greater damage for each successful hit; but the number of such hits will be smaller unless the weight assigned to the principal armament and its protection is increased so as to have an equal number of the larger caliber guns; and that means the construction of larger and more costly ships. Fancy pictures have been drawn of wholesale damage which can be done by the explosion on board a war-ship of one common shell from a 13.5-inch gun, and of its far-reaching and destructive effects as compared with those of a single shell from the 12-inch gun. The writer has witnessed many experiments with high explosives, and knows that enormous local injuries may be inflicted by a single shell explosion. Yet he ventures to doubt the accuracy of much that has been written both as to the vastly greater relative power of 13.5-inch shells and as to the absolute necessity for

adopting guns of that caliber in order to secure effective shell fire. Without assuming the rôle of a prophet he is of opinion that just as history is now repeating itself in regard to the adoption of larger calibers, so in the course of a few years it is likely to repeat itself by a return to more moderate calibers as experience is gained and extended firing trials are made with the larger guns now being introduced. All the reasons given above for preferring the 13.5-inch caliber to the 12-inch would apply also to an argument in favor of still larger guns; and it may happen that, before the tide turns, larger calibers than 14-inch will be again mounted just as was done thirty years ago. But the turn will doubtless come in due course and for the same reasons as before.

OLD TRANSATLANTIC STEAM LINERS.*

BY FRANCIS B. C. BRADLEE.

After the *Savannah* the first ocean-going steamers constructed in the United States were the *Lion* and the *Eagle*, two wooden side-wheel vessels, built by Jacob Bell at New York, in 1841, for the Spanish navy. They were about 154 feet by 30 feet by 14 feet 6 inches, with side lever engines (these particulars are taken from Morrison's History of American Steam Navigation), and these steamers were superintended during construction by the late Mr. E. K. Collins (the founder of the Collins line of steamers), and the Spanish Government was so much pleased with his work that it afterward sent him a service of plate.

In 1842 the steamer *Bangor* (built in 1833 for the Boston and Bangor, Maine, line, about 160 feet long, and fitted with a "crosshead" engine) was sold to the Turkish Government and sent across the Atlantic to Constantinople, leaving Boston August 16, 1842. She was in the service of the Porte for many years.

In 1845, the late Robert Bennett Forbes, of Boston, so long known for his connection with American shipping interests, built two wooden auxiliary screw steamers for the trans-Atlantic trade; the *Massachusetts* and the *Edith*. The former was somewhat the larger, being about 750 tons register, 178 feet long and 32 feet broad. Her machinery was designed by John Ericsson, and built by Hogg & Delamater, New York. The engines had two cylinders, 25 inches in diameter, working nearly at right angles to each other; the coal consumption was said to be only 9 tons, and the speed, in fair weather, about 7 knots. The shaft had the peculiarity of passing through the stern, at the side of the stern post, under a patent of Ericsson's. The propeller (also on Ericsson's principle) was 9½ feet in diameter and could be hoisted when the ship was under sail. For some reason or other, however, auxiliary steamers have never been popular, and the *Massachusetts* had made only one or two voyages between New York and Liverpool when she was chartered by the United States Government to carry troops to the Mexican War (1846), and was later brought into the naval service and known as the *Farralones*. The *Edith* never was in the trans-Atlantic service at all, and we believe was also bought by the United States Government.

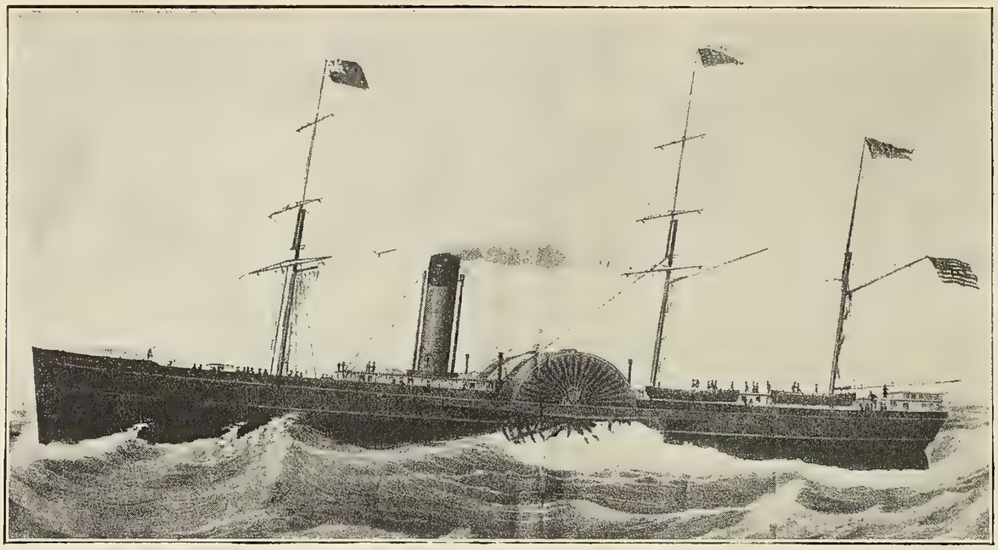
The continued success of the Cunard Line brought forth the feeling in America that the United States should have a line of trans-Atlantic steamers of its own, and in 1845 Congress passed a bill authorizing the Postmaster-General to solicit proposals for the transportation of mails to foreign countries. The first outcome of this was the formation of the Ocean Steam Navigation Company, who were to run a monthly line between New York and Bremen via Southampton, the subsidy being $200,000 (£41,000) per annum. At the outset, despite this large subsidy, there was so much doubt in New York regarding the success of the undertaking that most of the capital had to be raised in Bremen, and we believe that, although under the American flag and with its ships manned by Americans, this line was more under German than American control.

Two wooden side-wheel steamers were built at New York by Westervelt & Mackay for the Ocean Line: the *Washington* (which opened the service in June, 1847) was 1,700 tons gross, 236 feet long, 39 feet beam, 31 feet depth of hold; the *Herman* was slightly larger. The engines of both ships were exactly alike; constructed at New York by Stillman & Allen, of the side-lever type, with two cylinders, each 72 inches in diameter and 10-foot stroke. The paddle wheels were 35 feet in diameter, and at first great trouble was experienced with the machinery, the paddle wheels being too large and the boilers too small. As regards speed, the *Washington* and *Herman* were a disappointment; in 1851-52 (according to Stuart's Naval and Mail Steamers of the United States) their average passage to and from Southampton was about 14 days. They continued on the line until the end of 1857, when they were withdrawn and sent elsewhere. The *Washington* was

NEW YORK AND HAVRE STEAM NAVIGATION COMPANY'S FRANKLIN (1848).

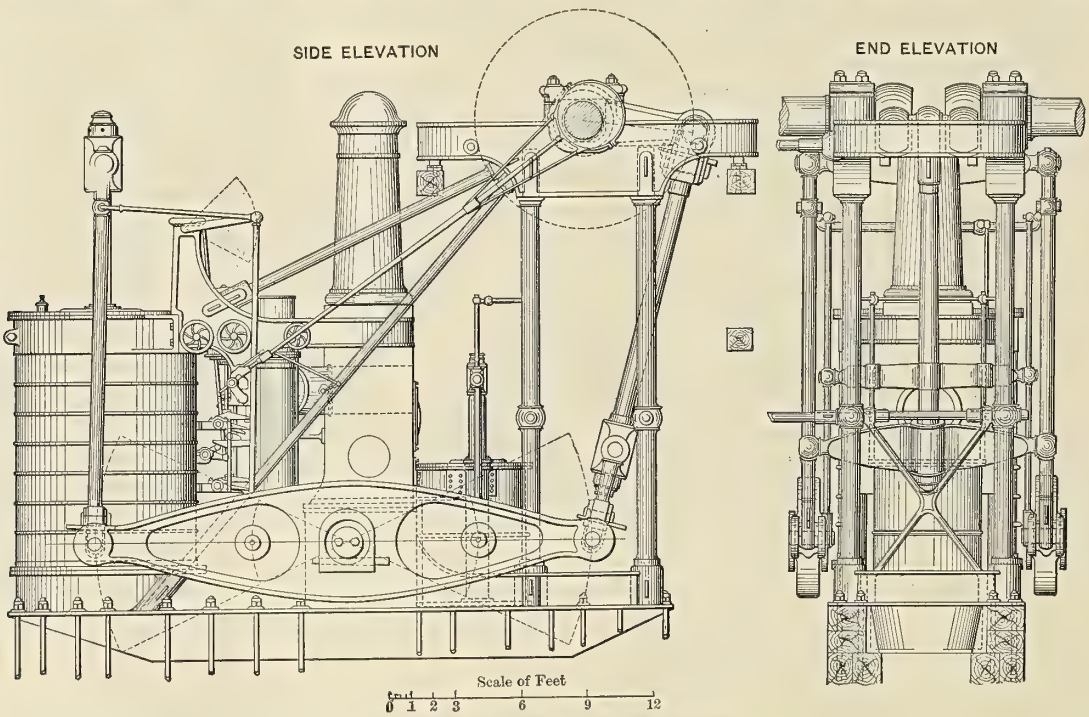
* Continued from the October issue.

broken up in 1863 and the *Herman* wrecked on the Japanese coast in February, 1869. At this time, and until 1869, the postage from the United States to England was 24 cents per half ounce and 48 cents per ounce, newspapers at 3 cents each.



COLLINS LINE STEAMER BALTIC (1850).

William H. Webb, in 1847, built for Messrs. C. H. Marshall & Co., the owners of the celebrated Black Ball Line of packet ships for the New York and Liverpool trade, the steamer *United States,* of 2,000 tons burden, 256 feet long, 50 feet beam, 30 feet depth, which in April, 1848, sailed on her first



SIDE LEVER ENGINE OF STEAMSHIP ARCTIC.

voyage to Liverpool. She made several voyages, including one between New York and New Orleans, but did not pay, and was sold to the Prussian Government, who made her into a steam frigate. The *United States* had the usual side-lever engines of that day and was the first merchant steamer constructed in this country to be of use as a man-of-war. She could be armed with two tiers of guns and had plenty of room in which to work them.

The New York & Havre Steam Navigation Company was established in 1848 by Messrs. Fox & Livingston to ply between New York and Havre via Southampton, and obtained a contract from the United States Government to carry the mails, for which they were to receive $150,000 (£31,000) per annum for a monthly service. Two vessels were built for this line in New York: the *Franklin* and the *Humboldt.* The former resembled the Bremen Line ships before mentioned, and the latter was built with a straight stem and more or less on the model of the Collins boats. The *Humboldt* was 2,850 tons gross, 292 feet long, 40 feet beam and 27 feet depth of hold, with side-lever engines having two cylinders, each 95 inches in diameter, 9 feet stroke; the *Franklin* was somewhat smaller, with much greater breadth of beam, and both vessels were, of course, constructed of wood.

These two ships carried on the service satisfactorily until December, 1853, when the *Humboldt* ran ashore while entering Halifax harbor short of coal, and became a total loss, and

the following July the *Franklin* was wrecked on Long Island. Happily there was no loss of life in either case, and to preserve the mail contract the service was carried on with chartered steamers until the new ships, *Arago* and *Fulton,* were built to replace those lost.

The *Fulton,* which sailed on her first voyage in February, 1856, was built of live oak at New York by Smith & Denison, and was 290 feet long, 42½ feet beam, 31½ feet depth of hold, gross tonnage 2,061, with oscillating engines with two cylinders, each 65 inches in diameter, 10 feet stroke, paddle wheels 31 feet in diameter. She could accommodate 150 first and second class passengers, 700 tons of freight and 800 tons of coal. The *Arago* was of nearly the same size and dimensions, and both ships were brig rigged, with two funnels, and both were fitted with water-tight bulkheads.

While the New York and Havre ships were never very fast, they had a great reputation for comfort and safety, and so were well filled with passengers, and financially they were by far the most successful of the American trans-Atlantic lines. On the breaking out of the Civil War in 1861, the *Arago* and *Fulton* were chartered as transports by the War Department at $1,200 (£250) a day each. In 1865, after the war was over, they were put back on the New York and Havre route, calling this time at Falmouth, England, and continued there until the autumn of 1867, when they were finally withdrawn. The *Fulton* was commanded at this time by Captain Samuel Samuels of *Dreadnought* fame. She was eventually broken up owing to dry rot, and the *Arago* was sold to the Peruvian Government.

We now come to the best known of all the efforts made to operate an American line of trans-Atlantic steamers, and this was the old Collins line, whose official title was the New York & Liverpool United States Steamship Company. It was founded by Edward K. Collins (owner of the Dramatic line of sailing packets), James Brown and other New York financiers, and in 1847 they made a contract with the United States Government to carry the mails between New York and Liverpool, making 20 round voyages a year, the subsidy to be $385,000 (£79,000) per year. One of the principal conditions of this contract was that the American steamers should be larger and make better time than the existing Cunarders.

Mr. Collins and his associates, accordingly, had built at New York in 1849, four side-wheel steamships of great size and power; the *Atlantic* (which inaugurated the new service in April, 1850), the *Arctic,* by William H. Brown, the *Baltic* and the *Pacific,* by Brown & Bell. They were built, in the heaviest and most substantial manner, of white and live oak strengthened by diagonal iron straps. The main keelson under the engine was of white oak and yellow pine and measured 22 inches in width and 42 inches in depth, but even this was not strong enough to withstand the "racking" of the engine being constantly driven at full speed. The Collins steamers inaugurated, too, several novelties; one of these being a kind of telegraph communication between the bridge and the engine room, there being several handles on the bridge marked respectively, "ahead," "astern," "stop," etc., which, when pulled, uncovered cards in the engine room bearing the same words. There was a system of bells on the same principle between the passengers' staterooms and the stewards' pantry. The passenger accommodation was considered sumptuous, including bath and smoking rooms, until then unheard of on steamers. All four steamers were at first bark rigged, but about 1854 their mizzen masts were removed, leaving them brig rigged.

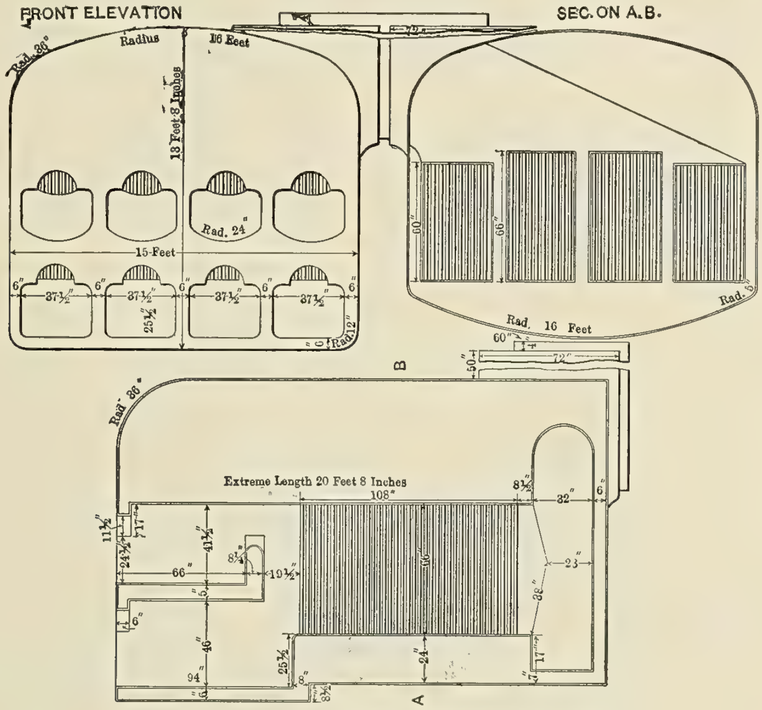


DIAGRAM OF BOILERS OF COLLINS LINER ARCTIC (1850).

The following description of the *Baltic* by Captain McKinnon, R. N., and published in Littells' Living Age for 1853, will apply equally to the other three vessels, the only difference between them being that the *Atlantic* and *Pacific* were two feet shorter than the *Baltic* and *Arctic,* and their piston rods had one foot less stroke:

"The American steamship *Baltic,* belonging to the Collins line, was built by Jacob Bell of New York at a cost of $710,000 (£145,000). She is barque-rigged and can spread about the same quantity of canvas as an ordinary sloop of war. Her dimensions are as follows: Length, 283 feet; breadth, 45 feet; depth, 32 feet, tonnage (gross), 2,723. She has a straight stem and three full decks, and with 1,100 tons of coal, 600 tons of freight, and with full complement of passengers and baggage she draws about 22 feet of water. She can accommodate 167 first class passengers and 38 second class. She is fitted with two side-lever engines, built by the Allaire Works, of New York (the Collins engines were all designed by John Farron,

engineer-in-chief of the United States navy), having 96-inch cylinders and 10 feet stroke; there are four tubular boilers, with two rows of furnaces, carrying steam at a pressure of 17 pounds to the square inch (the horsepower was 800 nominal and about 2,300 indicated), giving a speed at sea of from 12 to 13 knots on a coal consumption of from 80 to 87 tons per day. The highest speed she ever made at sea is 15 knots, and the least run for 24 hours, last winter, 167 nautical miles. I am only doing justice to these magnificent vessels in stating that they are, beyond any competition, the finest, fastest and the best sea boats in the world. I am sorry to be obliged to say this, but as a naval officer I feel bound in candor to admit their great superiority. Their extraordinary easiness in a sea cannot fail to excite the admiration of a sailor; I never beheld anything like it.

"There was none of that violent plunging—that sudden check usually attending a large ship in a heavy head sea. The elongated bow dipped gently in when a vast, wall-sided and threatening swell appeared overwhelmingly to rush upon her. The whole fore length of the vessel appeared to sink gently down, until almost level with the water, and as gradually to rise again after passing. From a considerable experience in all classes of steam vessels besides the Cunard *America,* I advisedly assert that the *Baltic* is out and out, by long odds, the very best and easiest steamship I ever sailed in."

The great defect in the Collins ships was their engines, which, being driven to their utmost capacity in all weathers, entailed heavy expenditure to keep in repair, and the *Atlantic* in March, 1851, and the *Pacific* in August, 1853, sustained serious breakdowns at sea. The fastest passages of these steamers were as follows:

Atlantic, westward, May, 1853, 9 days, 22 hours.

Pacific, eastward, May, 1851, 9 days 20 hours' record.

Arctic, eastward, February, 1852, 9 days 17 hours' record.

Baltic, westward, August, 1852, 9 days 13 hours' record.

Baltic, westward, July, 1854, 9 days 12 hours' record.

These passages were all between Liverpool and New York direct, as none of the trans-Atlantic liners called off Queenstown until 1859. The *Atlantic* was commanded by James West, the *Pacific* by Ezra Nye (afterwards by Captain Eldridge, who was lost in her), the *Arctic* by James C. Luce, and the *Baltic,* by Captain Comstock. Gustavus V. Fox, who, during the Civil War was the energetic Assistant Secretary of the Navy, was for several years chief officer of the *Baltic.*

(*To be concluded.*)

NEW SOUTHERN PACIFIC FREIGHT STEAMSHIPS.

A contract for four new freight steamships was placed with the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., several months ago by the Southern Pacific Steamship Company of New York. This contract was the fourth order for four vessels each which has been given the Newport News Company by the Southern Pacific Company. The same builders have also constructed two other freight and passenger steamships, the *Comos* and *Proteus,* for the same owners, thus making a total of eighteen large vessels which they have built or are building for the Southern Pacific Company. The fourteen vessels previously built were all from the same model, 390 feet long, 48 feet beam, 33 feet 9 inches depth, fitted with reciprocating machinery of 4,000 indicated horsepower, giving the ships a service speed of 14½ to 15 knots. All of these vessels are still in service in the Southern Pacific Company's fleet, except the first four built, which were sold to the United States navy during the Spanish War and converted into the auxiliary cruisers *Yosemite, Yankee, Dixie* and *Buffalo.*

NEW FREIGHT STEAMSHIP EL SOL, FOR THE SOUTHERN PACIFIC COMPANY.

The new ships, two of which, the *El Sol* and *El Mundo,* have been completed, and the other two, *El Oriente* and *El Occidente,* are still under construction, are single-screw steel vessels of the ocean-going, hurricane-deck type, 430 feet long over all, 412 feet long on the load waterline, with a molded beam of 53 feet, a molded depth to the hurricane deck of 36 feet, and a molded depth to the main deck of 28 feet.

The hull is sub-divided longitudinally by three complete decks and a partial orlop deck forward and transversely by six watertight bulkheads and two non-watertight bulkheads, forming athwartship coal bunkers. A double bottom extends under the engine room and thrust recess, which is utilized for carrying fresh water for boiler feed. Throughout the remainder of the vessel the ordinary type of single-bottom construction is used. Above the hurricane deck are two steel deck houses, one amidships, containing the accommodations for the officers and engineers, and one aft, containing the accommodations for the firemen and seamen.

BOILERS.

Steam for the main propelling and auxiliary machinery is supplied by three double-end Scotch boilers, fitted with heated forced draft. The boilers are located in a single compartment with two athwartship firerooms. The boilers are 15 feet 3 inches diameter and 22 feet long, designed for 200 pounds working pressure. The total heating surface is 15,630 square

feet, and the total grate surface 410 square feet. The furnaces are 39 inches diameter, four in each end of each boiler. Each furnace leads to a separate combustion chamber. The boiler tubes are 2¾ inches diameter, and there are 764 in each boiler.

All boilers are connected to a common stack, and the uptakes are fitted with air-heating boxes in connection with the forced-draft system. Two Sturtevant forced-draft fans of 60,000 cubic feet capacity per minute each are installed, one in each fireroom, in a recess in the coal bunkers. Each fan discharges air to all the furnaces in the fireroom in which it is located, the air being drawn from the firerooms and discharged into ducts around the air-heating boxes. This system insures a constant supply of fresh air being drawn into the firerooms, thus reducing the temperature as much as possible—an important point for a vessel that is to ply in Southern waters.

A donkey boiler, 12 feet 6 inches diamter by 10 feet long, is also provided for port use. The furnaces of this boiler, three in number, are also 39 inches diameter, and the working pressure is 200 pounds per square inch. The heating surface of the donkey boiler is 1,541 square feet and the grate surface 58½ square feet. There is also fitted in each fireroom one 6-inch See hydro-pneumatic ash ejector, and in each after fireroom a Williamson ash-hoisting engine, with cylinders 3½ inches by 3½ inches.

COAL BUNKERS.

There is one cross-bunker located at the forward end of the machinery space, and one between the boiler and engine rooms. The space abreast the machinery casings on the lower deck is also used for coal bunkers. The total bunker capacity is about evenly divided between upper and lower bunkers, both of which are filled at New York. On the trip south to Texas coal is used from the upper bunkers, so that on the return trip only the lower bunkers are full and the upper bunkers are available for cargo. Large watertight hinged doors are fitted in the bulkheads of this upper bunker space, to make it available for cargo-carrying. Four hinged coaling ports are fitted on each side of the vessel between the main and hurricane decks. The method of coaling is from barges by means of buckets handled by coaling booms located at the hurricane deck level. These coaling booms have leads to two single drums, 8 inches by 8 inches single-cylinder coaling winches, located in the deckhouse between the engine and boiler casings. A number of square hatches are fitted in the lower deck for trimming coal from the upper to the lower bunkers. Coaling scuttles, 24 inches diameter, are also fitted in the main deck, through which coal is dumped directly into the bunkers.

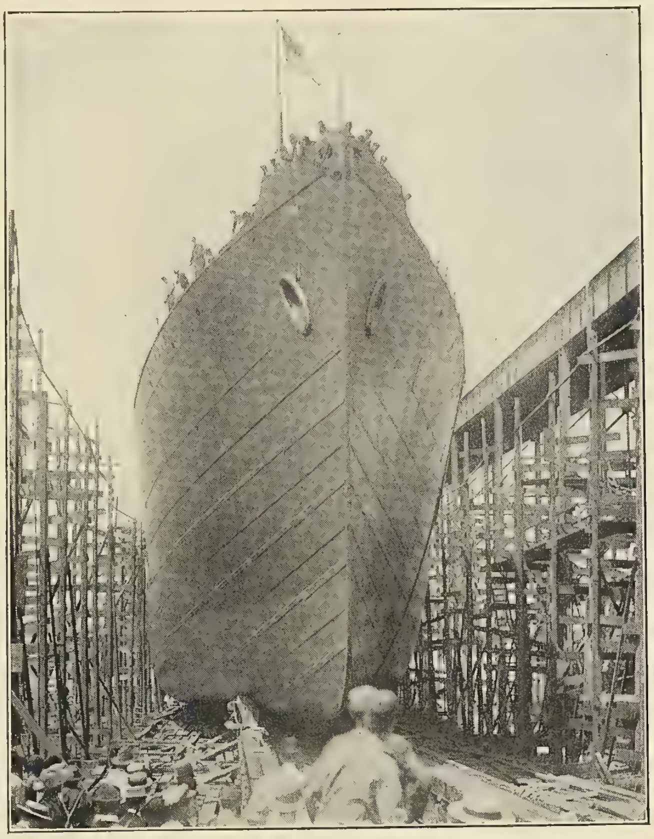
PROPELLING MACHINERY.

Propulsion is by means of a single sectional propeller wheel, with a cast steel hub and four manganese bronze blades. The propeller is driven by an inverted direct-acting triple expansion engine, having cylinders 34½ inches, 57 inches and 96 inches diameter by 60 inches stroke. Piston valves are fitted to the high and intermediate-pressure cylinders, one for the high and two for the intermediate, and a double-ported slide valve is fitted to the low-pressure cylinder. The valves are actuated by Stephenson double-bar link motion, fitted with the direct type of steam reversing gear. In the high-pressure cylinder there is a separate liner, and a cast iron piston is used. A cast iron piston is also used in the intermediate-pressure cylinder, and a cast steel piston in the low-pressure cylinder. The piston rods, cross-heads and connecting rods are forged steel. The cross-heads have double slippers of cast iron lined with white metal. The engine framing consists of cast iron housings of box section, fitted on a cast iron bedplate made in three sections. The crank shaft is of the built-up type in three interchangeable sections, and the material used here is also cast iron. The propeller shafting is of forged steel and the thrust block of the horseshoe type.

There is one surface condenser having a steel cylindrical shell, with brass tubes tinned inside and out which give a cooling surface of 9,300 square feet. Water is circulated through the condenser by an independent centrifugal pump driven by a 12-inch by 12-inch engine. The circulating water enters the bottom of the condenser and discharges at the top. The air pump is of the Edwards type and is driven together with two bilge pumps from the low-pressure cross-head.

AUXILIARY MACHINERY.

With the exception of the air and bilge pumps all of the pumps are of the independent steam-driven type, built by Blake & Knowles. There are two main feed, one donkey, one sanitary, one deck service and one oil pump. A Reilly feed-water heater and a Ross grease extractor are also fitted.



LAUNCH OF THE EL SOL AT NEWPORT NEWS.

Electric lights are fitted throughout the vessels, the electric plant consisting of two 10-kilowatt General Electric direct-connected marine generating sets located in the lower engine room.

The deck machinery includes a Hyde steam windlass, with horizontal wildcats for handling the anchors and chains. The windlass engine also drives two warping capstans. Aft, there are two similar capstans driven by a reversible 8-inch by 8-inch double cylinder capstan engine. The steam-steering gear is of the screw type, the engine having double cylinders, 10 inches by 8 inches, controlled from the pilot house and also from the warping bridge located at the level of the top of the after deckhouse. Hand-steering gear of the right and left-hand screw type is also located in the after deckhouse.

CARGO-HANDLING APPLIANCES.

Special attention has been given to the provision of means for economical and quick handling of freight. There are four

large hatches in each of the decks, two forward and two aft. Two of the hatches on the hurricane deck are of the over-all type, which, when opened in conjunction with the cargo ports directly underneath, afford splendid openings for the mechanical conveyors which are used in handling the cargo. These hatches are each fitted with watertight steel covers in four sections, the inboard sections being hinged. The other two hatches on the hurricane deck and the four hatches on the main deck also have hinged watertight steel covers, the covers being handled by the cargo booms. On each side of the vessel, between the lower and main decks, there are four cargo ports, each fitted with watertight hinged doors, in two sections divided horizontally. There are also four cargo ports on each side between the main and hurricane decks, the watertight hinged doors for which are divided vertically. These ports are all located to suit the gangways at the Southern Pacific Company's terminals.

The facilities for handling cargo through the hatches comprise four cargo booms on each mast, two on each side. As the foremast is located between the two forward hatches, and the mainmast between the two after ones, each hatch is served by two cargo booms, one port and one starboard. Each of these cargo booms has a lifting capacity of 7½ tons and the length varies from 47 feet 3 inches to 57 feet 6 inches. Each cargo boom is operated by a single drum, 9-inch by 10-inch single-cylinder winch, located on the main deck. These winches are fitted with vertical shafts and gear for driving vertical gypsies on the deck above.

HULL CONSTRUCTION.

The framing of the vessel is of channel section, each frame extending to the hurricane deck. Both the lower and main decks are of steel, while steel stringers and tie plates are fitted on the hurricane and orlop decks. In way of the over-all hatches on the hurricane deck, heavy stringers are provided, together with two tie plates, which are rigidly connected to steel castings securely fastened to the deck on the forward and after sides of the hatches. The hurricane and orlop decks are planked with yellow pine, and on two of the vessels the main deck has a yellow pine-calked deck on top of the plating. The deck beams are also of channel section and are supported by two rows of longitudinal girders, with wide-spaced stanchions. From the keel to the load waterline the shell plating is joggled, and above the waterline it is fitted in inside and outside strakes.

ACCOMMODATIONS.

Exceptionally well-appointed accommodations are provided in these new ships for both officers and crew. The captain's and deck officers' quarters are in a deckhouse forward on the hurricane deck, the pilot house being above the officers' deckhouse, with a flying bridge located at the level of the top of the ladder. The captain's quarters consist of an office and separate stateroom finished in mahogany, with a private bath connected to the stateroom. An officers' toilet, with shower bath, is also provided in the upper house. A chart room is so located as to be accessible from all officers' rooms, and an inside stairway leads directly to the pilot house above. Quarters for the engineers, steward, petty officers, etc., are located abreast the engine casing. A separate room is provided for each engineer. These rooms all have doors opening out on the deck, and the engineers' rooms also have doors opening on passages inside the deckhouse. A bath tub is provided for the engineers and a separate shower for the petty officers.

The captain's messroom, seating eight, and the officers' messroom, seating sixteen, are located in the forward end of the lower deckhouse. The captain's messroom is paneled in mahogany, and the officers' is finished in a cherry wainscoting, with ash panels above. The galley extends the full width of the deckhouse and is located just forward of the boiler casing. Between the galley and the messrooms are the pantry, steward's storeroom and cold storage room. Separate messrooms for the firemen and seamen are located in the deckhouse at the sides of the boiler casing.

To fulfill the contract requirements these vessels must maintain an average sea speed of 15¼ knots for the round trip between New York and Galveston when loaded with 4,000 tons of cargo in addition to full water, stores, etc., the coal consumption not to exceed 1.6 pounds per indicated horsepower per hour. The *El Sol*, which was the first of the four vessels to be completed, averaged on her maiden trip over 16 knots for the round trip, the coal consumption averaging less than 1.5 pounds per indicated horsepower per hour.

THE MARINE STEAM ENGINE INDICATOR—XVI.*

BY LIEUT. CHARLES S. ROOT, U. S. R. C. S.

THE STEAM LINE.

The steam line *B C* of Fig. 95 (see September issue) shows the percentage of boiler pressure realized in the cylinder at the commencement of the stroke, and indicates how well this pressure is maintained to the point of cut-off. From the information thus obtained, we can estimate the sufficiency of the pipes, steam passages and port openings; the relative speed of the valve in closing at cut-off and the approximate position of the piston when cut-off takes place. In order that any fluid may flow from one point to another—and steam is no exception—a lower pressure must exist at the point towards which the flow takes place. This explains why the initial pressure in the cylinder is always a little less than the boiler pressure, no matter how large and straight the passage between the boiler and cylinder. The *initial pressure,* referred to above, is the pressure in the cylinder at the beginning of the stroke, and is represented by the height of the steam line above the atmosperic line at that point. *Initial absolute pressure* is represented by the height of the steam line above the line of zero pressure or absolute vacuum.

If the steam passages are of such size that the steam will have to flow at a speed greater than 6,000 feet a minute in order to supply the engine, the friction will be excessive and the pressure drop more than necessary. Other causes con-

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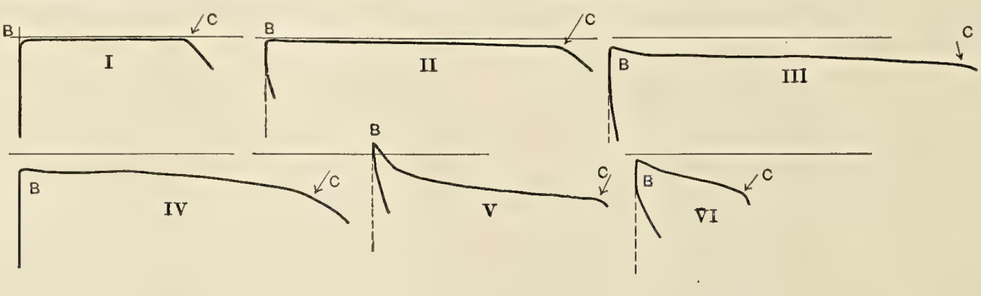


FIG. 97.

tributing to loss of pressure are stop valves, separators, short bends, contracted port opening, rough and crooked steam passages in the cylinder castings and initial condensation.

At I. (Fig. 97) is shown an ideal steam line. This is part of a diagram taken from the high-pressure cylinder of a compound pumping engine built by Geo. H. Corliss, of Providence, R. I., and fitted with the valve gear which bears his name. *B C* is the line of boiler pressure, and the steam line is within 2 pounds of and parallel to it throughout its length, showing that the pressure is constant to cut-off. The sudden drop in pressure at *C* shows that the valve closes smartly. In this engine all the conditions are favorable to good results. The steam pipe is ample and has easy bends, the cylinder ports are short and large, the piston speed is low and the valve gear is of a type which closes the valve almost instantly.

Diagram II. (Fig. 97) is another good example. This is from the 19-inch high-pressure cylinder of an 1,800 horsepower engine of a cargo steamer. The engine is fitted with a radial valve gear of the Joy type and uses superheated steam. The boiler pressure is 245 pounds gage, and the pressure at effective cut-off (*C*) is 232 pounds, or nearly 95 percent of the boiler pressure. This is an unusually good result. If the initial pressure is within 5 pounds of the boiler pressure, and the pressure at effective cut-off is within 80 percent of boiler pressure, the results are considered good in marine practice. Diagrams III. and IV. are good average steam lines from the high-pressure cylinders of marine engines. Diagram V. is from the high-pressure cylinder of a torpedo boat engine running at full power, and shows excessive lead and wire drawing. Diagram VI. is from a dynamo engine and shows the same defects.

From the ordinary diagram it is impossible to tell whether the pressure loss is due to the piping or to the valve gear and ports. To determine this it is necessary to apply the indicator to the steam chest. This is done by attaching the instrument so that it will be in communication with the valve chest and taking the drum motion from the regular reducing gear. Simultaneous diagrams should be taken from the cylinder and valve chest with the same scale spring. The diagrams will be of the same length if the ends are well stretched. Cut

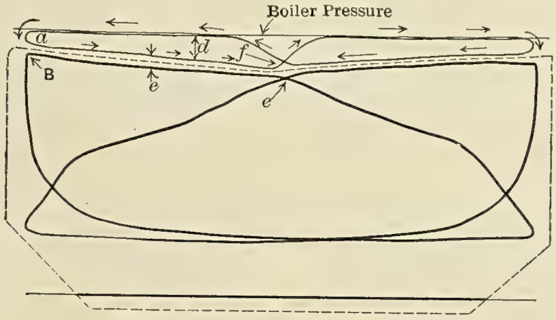


FIG. 98.

out the cylinder card, as shown in broken lines in Fig. 98, and paste it over the steam chest card, making the atmospheric lines coincide, lining them up horizontally at the same time. The valve opens to steam at *B* and the chest pressure falls at once, as shown at *a*. As the piston commences to move faster, and the heavy draft of steam begins, the pressure in the chest continues to fall, reaching its lowest amount at *f*. Cut-off occurs at *c* and the chest pressure rises again to the boiler pressure line. The indicator pencil moves in the direction of the arrows. The length of the vertical line *d* at any point represents the loss of pressure due to the friction in the steam pipe and its fittings, and the distance *e* the loss due to wire drawing in the ports and passages.

In any engine, if the steam line drops at all, the slope will be greater on the top cards, due to the influence of the angularity of the connecting rod, which causes the piston to move at its greatest speed when making the down stroke. In the intermediate and low-pressure cylinders of multiple expansion engines, the steam lines are variously affected by the sequence of the cranks, the angle between them and the points of cut-off in the several engines. In the compound engine, where the high-pressure steam line is shown at I. (Fig. 97), cut-off takes place in the low-pressure before release in the high-pressure. In this case, the steam line produced is, in reality, an expansion line, the low-pressure valve chest or receiver being a closed chamber filled with steam and with no opening, but the steam passage to the low-pressure cylinder. As the low-pressure piston advances the steam in the receiver and cylinder expands as one body, and the pressure falls as the volume increases, causing the steam line to fall, as shown at I., Fig. 99. It is evident that, no matter how ample the ports, the pressure is bound to fall.

The steam line shown at II. (Fig. 99) is from the low-pressure cylinder of a compound marine engine. In this engine

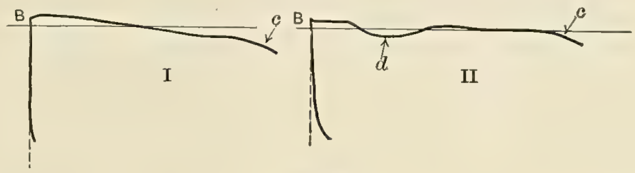


FIG. 99.

the high-pressure release is earlier and the cut-off later than in the previous diagram. The pressure falls from *B* to *d* in the usual manner. At *d* release in the high-pressure takes place, and the fresh steam injected into the receiver raises the pressure and holds it well up until cut-off occurs at *c*.

In Fig. 100 we have a diagram taken from the intermediate-pressure cylinder of a triple expansion engine. When release occurs in the high-pressure cylinder the high-pressure crank pin is at *H* and the intermediate-pressure pin 120 degrees behind it at *M*. Owing to the connecting rod angularity the intermediate-pressure piston is on the line *di*. The stroke begins with the pressure at *B*; at *d* the high-pressure exhaust blows into the intermediate-pressure receiver, raising the pressure as shown. The high-pressure cylinder, the intermediate-presure receiver and the intermediate-presure cylinder are now in communication, and by the time the

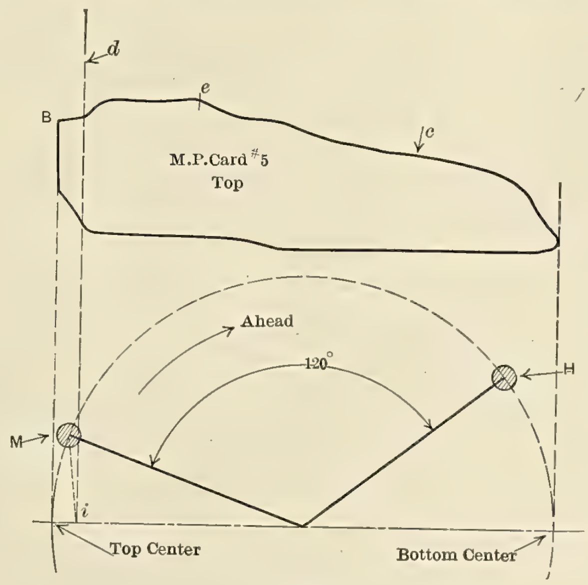


FIG. 100.

intermediate-pressure piston has reached *e*, the pressures in all three are very nearly equalized and the steam in these spaces commences to expand together as the intermediate-pressure piston advances. Cut-off occurs at *c*, but the point cannot be distinguished. Owing to considerations of weight and space, the steam ports and pasages in intermediate-pressure and low-pressure cylinders of marine engines are necessarily contracted, and steam speeds of 7,000 to 10,000 feet per minute are more common than speeds of 6,000 feet. In view of these facts, it is evident that no judgment can be formed relative to the sizes of steam ports in these cylinders without the aid of additional diagrams taken from the receiver spaces.

(*To be continued.*)

THE PRACTICAL OPERATION OF STEAM TURBINES AND RECIPROCATING ENGINES.

BY FRANCIS J. S. NOLAN.

The practical operation of steam turbines and reciprocating engines is at present being given a great deal of thought by shipbuilders, shipowners and marine engineers. It has taken a century to bring the reciprocating engine to its present stage of development, but the steam turbine is hardly with us ere it is installed in hundreds of ships of all classes, from battleships and ocean greyhounds down to small freighters plying round our coasts. The different types of steam turbines which have, from time to time, been brought before us have been many, but none has as yet reached such a high status in the marine world as the Curtis and Parsons turbines. Both of these types have their advantages and disadvantages, but be it said to the credit of both that in several ways they are more economical than the piston engine.

For example, take the work that has to be done when a ship fitted with reciprocating engines reaches port. I instance an Atlantic liner running the mails between England and New York.

The mail ship may take anything from four and a half to six days to make her run across; she reaches New York, and then a vast amount of work has to be begun and finished at the latest in four days. All the engine-room staff and several of the fireroom staff are pressed into service, so that the work may be got through with on time. The heavy work done in the engine room of a twin-screw Atlantic liner, when she reaches New York, is very great and includes the following: Four crank pins to be examined and have leads taken off them; four cross-heads to have the same amount of work done on them; four main bearings to be also treated in a like manner; all top plugs taken out of cylinders, pistons, junk rings and cylinder walls examined.

I will try to give in detail all the work necessary to overhaul the above-mentioned parts, in order to draw a comparison between the ship fitted with turbines and the ship fitted with reciprocating engines.

In order to overhaul a pair of cross-head brasses it is necessary to take down all the oil service pipes from the gravity oil boxes on the cylinder tops. These pipes, while down, are blown through with steam, and any foreign matter which may have lodged in them is at once removed.

From a lug cast on to the bottom of the cylinder is attached a shackle and a pair of chain blocks, the cross-head nuts are then slacked back with a spanner and ram, an eye-bolt is screwed into the steel cap of the cross-head, the blocks are hooked on the eye-bolt, and the heavy steel cap and top half of the brass are then lifted off by means of the blocks, cleaned and examined; two bits of lead wire, about 1/16-inch in diameter, are laid on the cross-head pin, the brass and cap are then again lowered into their place, and the nuts are driven hard up by means of an iron ram used on the end of a short spanner, the ram being suspended from overhead by rope slings.

The nuts having been driven up to a given mark, the spanner is reversed and the ram is brought into action on the other side of the spanner, the nuts are slacked off, and cap and brasses lifted with the chain blocks as before; should the leads prove to be too thick, then a liner, of which there are several fitted to each pair of brasses, is removed, and leads are taken once more. This process is repeated until the leads are brought to the required fineness, and then the cap and brass are replaced and tightened up for working.

We next come to the four pairs of crank-pin brasses which have to be overhauled. Two pairs of chain blocks are rigged up, one on either side of the connecting rod, the engine having been turned on the top center. The blocks are suspended by two eye-bolts screwed into holes in the bottom side of the cross-head. A heavy spanner is then placed on the crank-pin nuts, two eye-bolts being inserted into the top of the crank-pin bolts; the chain blocks are then hooked on to these eye-bolts, and a pair of rope blocks are led from a shackle in the end of the spanner to a hand winch on the engine-room bulkhead, the fall of these rope blocks is taken round the barrel of the winch and is heaved taut by two men, the ram is then brought into action on the other side of the spanner until the nut is slack enough to turn by hand. The same process is gone through with the other nut; both nuts are now screwed off the bolts, and the chain blocks now having the whole weight on them, the whole thing is lowered into the crank pit. The top half of the brass is then bolted to the bottom of the connecting rod, and strong backs are put underneath the slippers and across the guides, to take the weight of the piston, piston rod, connecting rod and brasses; the engine is then turned down and the rod swung, the top brass is cleaned and examined; the bottom half having been treated in a like manner, the engine is turned back again to the top center. The whole thing is lifted up again out of the crank pit, and leads are taken off it in the same manner as was done in the case of the cross-head brasses. This performance is repeated until such time as the leads are fine enough to give the bearing a good running surface without it being too tight.

We next come to the main bearings. The nuts are slacked back in the same manner as before, with a ram and spanner, and rope blocks led from the spanner to the winch on the bulkhead. The steel cap, which in some ships weighs as much as 20 hundredweight, is then lifted and slung to one side, the brass is then taken up, cleaned, examined, leads are put on the shaft, and the brass and cap are put down again and the leads taken off in the usual way.

Next we have all the cylinders to examine, which are eight in number in most liners which are twin-screw. Round plugs, weighing about 6 to 8 hundredweight, are fitted to the cylinder cover by means of a flange, which is cast on them, and are held in place by means of studs and nuts. The nuts having been taken off, the plug is lifted out by means of blocks and tackle. The inside of the cylinder is then examined, every junk ring bolt being sounded with a hammer, also the nut holding the piston in place is sounded for slackness, the cylinder walls are examined and usually painted with a thick coat of black oil. The examination being completed, the plug is dropped into place and screwed up, the examination takes place in each cylinder and any slack bolts or nuts are made good.

The next thing which demands the attention of those who are preparing the ship for her next voyage are the several auxiliaries, each performing its own important duties.

The electric light engine has to be overhauled. The crank-pin brasses, cross-head brasses, must have leads taken off them. The piston must be taken out and the cylinder examined, and all valve gear attended to and steam glands re-

packed. Next come two of the main circulating pumps for the main condensers, which have to receive the same amount of attention as the electric light plant. We next have a range of boiler feed pumps, six in all, two of which have to be overhauled each time the ship reaches New York. The steam chambers and water chambers are opened up and the steam piston and water bucket are drawn out and the chambers examined, all the water valves are also taken out and the worn ones are replaced by now ones, the valve gear is taken down and the shuttles examined, cleaned, oiled and put back, and new joints are made for steam and water ends where required.

All this work, as well as a host of other small jobs, is done in four days, and even in spite of all this there is a throb and vibration about the ship fitted with reciprocating engines that one doesn't get in the ship which has a turbine plant aboard.

I will now turn to the ship fitted with turbine engines. There is no heavy work to be done, all the work that is done is on the auxiliaries. In this type of ship, of course, there are more auxiliaries than in the ship fitted with reciprocating engines, the same overhauling has to be done to the auxiliaries in the turbine ships as to those in the reciprocating engined ships, but the work for the greater part is only of a trifling nature; a few steam or water joints may have to be remade and a few glands, water and steam repacked. An examination is also made of the interior of the turbines, which only entails the taking off of a few man-hole doors to gain admittance.

Several small doors are also taken off the main condenser sea-water side, so that the tubes may be inspected and any dirt which may have come thorugh the main injection and lodged in the tubes can easily be removed. In most ships fitted with turbines a turbo-generator is installed for the electric plant. This, again, does away with a lot of work which would be necessary were a piston engine fitted.

With the steam turbine the noise or vibration is hardly worth speaking of; the engine-room staff can be reduced by half that required with reciprocating engines, most of the oiling being done by forced lubrication. It has been found that in properly balanced rotors the vibration is only a very small item.

In the two types of steam turbines used to-day for marine purposes there is not much to choose. The turning effort of a steam turbine is obtained by the impulse or reaction of the steam in passing through the moving blades, and all designs embody one or more of these methods. From a mechanical and operating standpoint those turbines operated solely by impulse have a decided advantage over those operated by reaction, owing to the great clearance which can be allowed between the blade tips, and the cylinder, and the spindle. Those operated by reaction, however, have led the way in obtaining low steam consumption; and on account of this, the disadvantages of small clearances have been accepted.

From the operating standpoint the sole objection raised to the Parsons type is the possibility of the blades stripping or the dummies seizing. Should it so happen that one of the main bearings got overheated and the white metal run out, the blades on the rotor would at once come into contact with the bottom casing, and the effect, needless to say, would be disastrous to the rotor and casing alike.

In the Curtis system the steam moving at high velocity passes directly across the blades and has no tendency to pass round them; consequently, not only does all the steam that passes through the turbine do useful work, but the clearances between the blades and the casing may be made large, and the danger of contact between the two, with its disastrous stripping of blades, is avoided. The clearances in this type vary from ¼ inch to 2 inches, a smaller number of blades are necessary, construction of blading may be made much stronger, separate cruising turbines are not necessary, and the amount of power developed on the shaft is under close control.

In the reciprocating engine the rods, guides and valve fittings account for more dissipation of heat than the whole radiating surface of the cylinder. In the turbine the principal losses are internal nozzle friction, skin friction, wheel friction, and exit velocity, and, in the case of reaction machines of the Parsons type, leakage round the blade ends. Radiation from the turbine to the surrounding air is almost immeasurable, as the surface presented to the air is very much smaller, compared to the power, than in the case of the reciprocating engine. It is also easier to insulate the turbine thoroughly, not only because of the simplicity of lagging and the absence of externally moving parts, but because of the absence of large bodies of metal, such as guides, rods, etc., leading from the steam chamber to the unlagged cool parts.

Leakage over the tips of the blades is perhaps not so detrimental in the Parsons type on account of actual leakage loss as in its superheating effect on the steam, the row past which it leaks and the last row, which, it is well known, seriously affects the fluid efficiency.

The trouble with the stripping of blades may be set down to bad workmanship, defective blade material, whipping of spindles due to bad design, or bad balancing, and to the excessive cylinder distortion due to differences in temperature. This last has been found to be the most fruitful cause, and is a really serious one, being due entirely to poor design. It has been found that great care must be taken in proportioning the cylinders; for under wide ranges of temperature, when the turbine is working, there may be a fall of from 400 to 150 degrees F. in a distance of 5, 6 or 8 feet. The radial expansion, therefore, is greater at one end than at the other. It has, therefore, been found that a good clearance is necessary.

In most ships fitted with turbines it has been shown that only below 45 percent its full speed does the consumption of the turbine exceed that of the reciprocating engine.

It has also been shown that the *Lusitania* is 16 to 20 percent more efficient than the greatest reciprocating plant afloat. In 1907, the *Lusitania* consumed 12 pounds per shaft horsepower, and in 1907 the *Mauretania* consumed 11½ pounds per shaft horsepower. The last figures represent about 69 percent of the energy available in the steam, and is certainly worth taking notice of, both as to where the increase in economy has taken place and what is possible in the future.

It has been found by practical test that, adding, say, 30 pounds to the steam pressure at the high-pressure receiver improves the efficiency of the turbine only a little and adds to the weight of the turbines.

Considering turbine machinery, further reductions in weight cannot be expected until some great advance is made in the development of high-speed propellers or, *vice versa*, in the discovery of some type of turbine more suitable for low-speed running than the present patterns. The turbine problem is inherently bound up in that of the propeller, the present state of compromise being the best that can now be arranged.

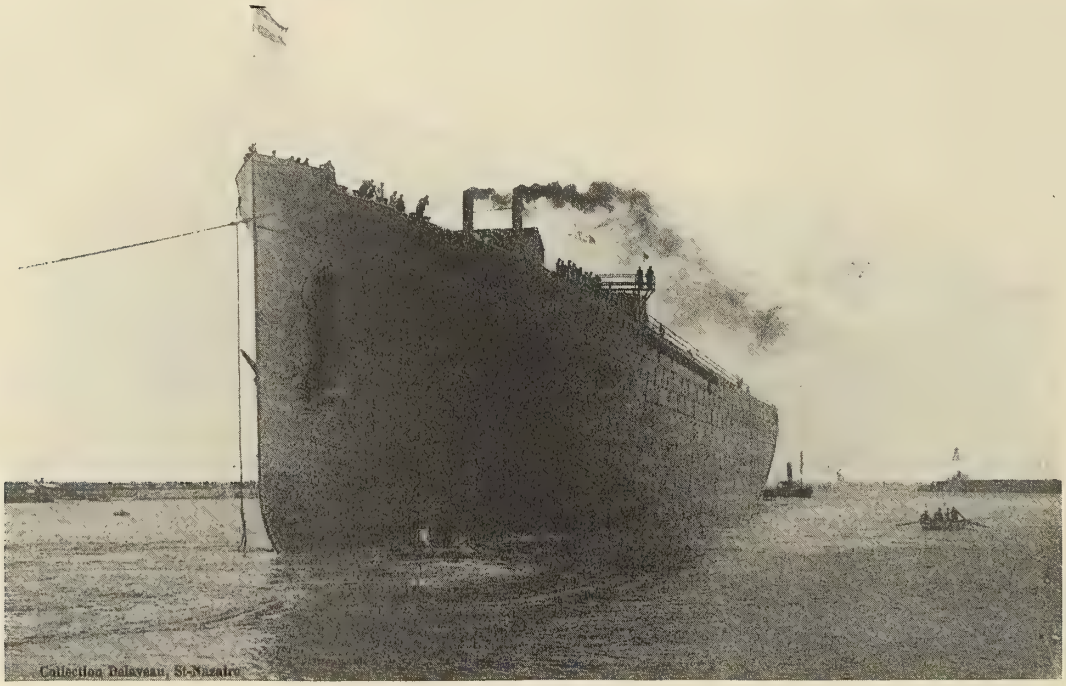
When the problem of reversing turbines has been solved we may expect a much further reduction in weight. The turbine requires the same auxiliaries as the reciprocating engine and a few additional ones, besides larger condensers and air pumps. There is another advantage the turbine holds over the reciprocating engine, and that is where the priming of boilers occurs. Priming is an evil which often takes place even in the best-designed reciprocating engines and turbines on board ship. The causes of priming are many, from an operating standpoint. The following have been found to be serious causes of priming on board ship: Irregular firing of boilers, a mixture of quick and slow evaporating coal, dirty boilers, and the rolling and pitching motion of a ship in a heavy sea way.

In the reciprocating engine priming is one of the worst enemies to be contended with. It is not an infrequent thing to

have burst cylinders, split cylinder covers, and bent piston rods—all the fruits of priming.

In the turbine priming is a serious malady; the water coming from the boiler may bring with it foreign matter, which may adhere to the blades, especially in the reaction type, where the blades have not got much clearance. Here, again, the impulse type gains a point. Owing to its greater clearance, it is able to clear itself much sooner of water, and the chances of stripping the blades are not so great.

ship. The double bottom is divided into 16 watertight compartments, having a total capacity of 2,500 tons of water. This will enable the steamer to maintain the best trim under any conditions of loading. There are 12 watertight bulkheads, and where it has been found necessary to pierce the bulkheads with doors, the Stone-Lloyd improved hydraulic system of closing the doors has been established. There are in all 20 of these watertight doors, which may be closed at will from the navigating bridge, either all at once or separately,



THE LARGEST FRENCH STEAMSHIP AFLOAT.

THE FRENCH LINER FRANCE.

What is destined to be the largest and speediest boat of the French merchant marine was launched September 20 from the yards of the Atlantic Works at St. Nazaire. The *France*, as she was christened, is of 23,000 tons gross and 45,000 horsepower, and it is expected that she will make the passage across the Atlantic between Havre and New York in five and one-half days. The keel of the *France* was laid April 20, 1909, on the day following the launch of the 18,000-ton battleship *Diderot*. Her construction has been somewhat delayed on account of labor trouble, so that seventeen months were required to bring her to the launching stage. It is expected, however, that she will be placed in service early in 1912. The principal dimensions are as follows:

Length over all	715 ft. 3 ins.
Length between perps	685 " 2 "
Breadth, molded	75 " 5 "
Depth to "D" deck	52 " 10 "
Depth to "A" deck	78 " 9 "
Draft, loaded	29 " 6 "
Displacement	27,000 tons
Gross tonnage	23,000 "
I. H. P.	45,000 "
Designed speed	23.5 knots

The hull is built of Siemens-Martin mild steel and special high tensile steel has been used for the superstructure. Three plates, having a total thickness of about 3 inches, were used for the keel, and the bottom of the ship is further strengthened by a double bottom worked nearly from end to end of the ship. The double bottom is divided into 16 watertight compartments, having a total capacity of 2,500 tons of water.

as may be desired. Seven powerful steam pumps, having a total capacity of 2,500 tons of water per hour, will be able to maintain the ship afloat in case of leakage.

The machinery space occupies a length of 470 feet amidships. The remainder of the space in the hold is occupied by dynamo rooms, bunkers, cargo and parcel-post rooms and holds. The vessel has a capacity for 6,000 tons of cargo and 5,500 tons of bunker coal.

There are 8 steel decks, of which the 5 upper ones are covered with wood. Counting from the bottom, the fourth 'tween deck or "H" deck, is taken up principally by cargo and bunker space. There are also large storerooms for daily stores and refrigerating rooms for meat, poultry, fish, game and vegetables. The passengers' luggage room is also located on this deck.

The deck above, or the "G" deck, is devoted to the crew and steerage passengers. On the second 'tween deck, or "F" deck forward, there are quarters and galley for the crew; additional accommodations for steerage passengers, together with their galley and mess room. Amidships is the lower first-class dining room, also the children's dining room. Astern are the first and second class galleys and the second class dining room surrounded by second class staterooms.

The "E" deck is entirely devoted to passengers. In the forecastle are the petty officers' quarters, the infirmary and the two ships' hospitals. Then come the cabins, staterooms, dining room, smoking room and galley for the third class passengers. Amidships is the upper first class dining room and numerous staterooms. Aft are second class staterooms and close to the stern are quarters for the musicians.

The main deck, or "D" deck, is divided as follows: Forward,

is a promenade deck for steerage passengers; amidships, the space is devoted to first class passengers, including the entrance hall and other public rooms. Abaft the second group of funnels is the second class social hall and smoking room. The after part of this deck is reserved as a promenade for engineers, firemen and petty officers. The deck, both forward and aft, is fitted with the ordinary auxiliary machinery, including capstans, winches, etc. Close to the room containing the steering engines are several small storerooms.

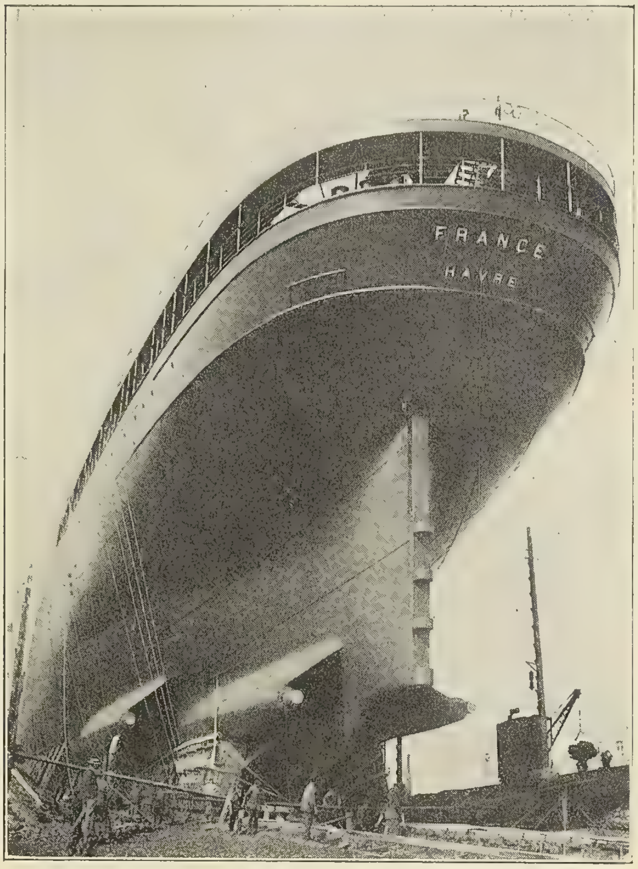
On the "C" deck are located large deck houses, in the forward part of which is a series of cabins de luxe and staterooms, also the telephone and wireless telegraph office; amidships is the main entrance for first class passengers, also the drawing, writing and reading rooms, music room, etc. The after part of this deck is reserved as a promenade for second class passengers.

In a large deck house on the "B" deck are located the officers' quarters, children's play room, library, printing office and, amidships, the social halls. Abaft the second group of funnels is a café, smoking room and open-air café or veranda.

The "A" deck is reserved as a promenade for first class passengers and will carry 20 lifeboats, each 20 feet long by 8 feet 6 inches broad, together with other smaller boats and life rafts. Welin quadrant davits are installed for handling the boats. At the forward end are the captain's apartments, and above these the chart and pilot house and flying bridge, the latter being 54 feet above the load waterline.

From the foregoing description of the arrangement of the vessel, it is evident that various classes of passengers will be entirely separated from each other, but special care has been given to the ventilation of all passenger accommodations, electrically-operated fans being installed throughout the ship.

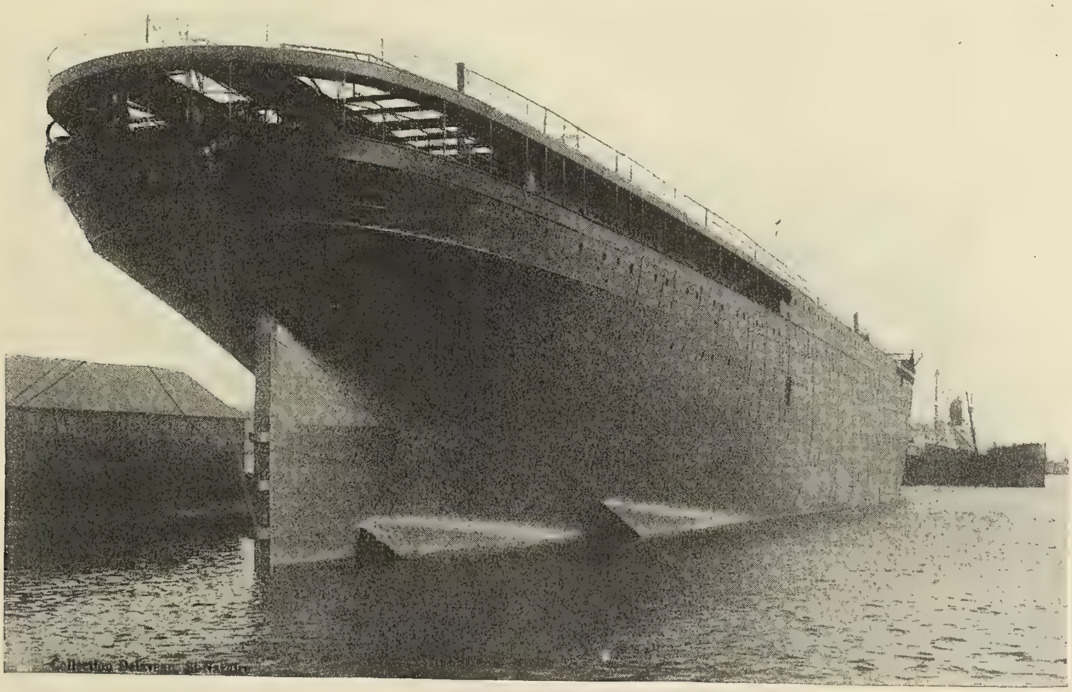
Boilers of the Scotch type have been adopted, and there are 20 in all of the single and double-ended types. They are constructed of semi-hard steel and have been tested for 200 pounds normal pressure. The grate and heating surfaces are 2,600 and 10,110 square feet respectively, the ratio being 1 to 38. The boilers are divided into four groups, each having its own funnel, 112 feet high above the grate bars and 17 feet 5 inches diameter. The boilers are all operated by



ARRANGEMENT OF TURBINE SHAFTS WITH INCLINED BOSSING.

Howdens' forced draft system, which is maintained by electrically-driven fans.

The main engines are of the Parsons type, and the four-shaft arrangement is employed. There are two high-pressure and two intermediate-pressure ahead turbines located in the first compartment, together with the high-pressure astern turbines, the auxiliary condenser and about half of the aux-



STERN VIEW OF THE FRANCE IMMEDIATELY AFTER LAUNCHING.

iliaries. These turbines drive the wing shafts. There are two low-pressure ahead and two low-pressure astern turbines, driving the center shafts and located in the second compartment, together with the main condensers and the remaining auxiliaries.

The turbine casings have been made of cast iron and the rotors, as well as the disks, were machined out of ingots. The blading has been carried out according to Parsons' latest improved system, with the usual method of binding. The hollow shafts are made from steel ingots. The four-bladed propellers each have a diameter of 13 feet 2 inches and have been designed for working between 220 and 240 revolutions per minute. They are of manganese bronze. The total weight of the turbines is 730 tons and of the shafting 160 tons.

The electric plant consists of four generators operating at 220 volts at the terminals, driven by steam turbines. They will supply the necessary current for 4,000 lamps, also for motors operating the winches, fans, elevators, etc. The refrigerating plant, which is of the Linde patent, has been designed to maintain a temperature of —5 degrees in the cold chambers. The crew will consist of 60 officers and deck hands, with 260 men in the engineering department and 275 in the civil department.

The builders are to be congratulated upon the successful launching of this vessel. The launching operation itself took only 45 seconds and cost $47,500 (£9,800). The total launching weight, including the cradle, was 12,100 tons, which is a record in French shipbuilding.

COLUMN TABLES FOR SHIP WORK—II.

BY R. EARLE ANDERSON.

RATIONAL FORMULAS.

It has been shown in the previous section that the commonly accepted empirical formulas are unsuited to our purpose, largely because they provide no basis for passing from one material to another. If, however, a strictly rational formula can be found which is substantiated by all available test data, it may safely be relied upon for materials for which no test data is to be had, particularly if the test data upon which it rests cover a very wide range of materials.

Such a formula has been proposed by Moncrieff (Trans. Am. Soc. C. E., XLV., 1901). His formula is cumbersome, which has probably prevented its general use, but, as already pointed out, this need not prevent its use for the preparation of tables. Moncrieff gives the most complete resumé of tests which is anywhere to be found, classifies them (failure to do which has led to some confusion in the case of other authorities) and compares his formula with each class of tests, with the result that its correctness is fairly established. There are several other rational formulæ, notably that of Prof. J. B. Johnson (Framed Structures, page 144). They do not rest upon as complete a comparison with test data as does Moncrieff's, however. Johnson's formula is very similar to Moncrieff's, and would probably give equally good results. It appears necessary, however, to consider only Moncrieff's formula, particularly as he embodies in its derivation several considerations overlooked by others and which appear to be vital. It should be stated that the Moncrieff formula here referred to is that for the ultimate strength of the column, and not for safe working load, a matter which will be discussed in a succeeding section. Moncrieff's formula is based upon the stress produced in the extreme fiber, when the column deflects under a load supposedly central, but actually eccentric. It is pointed out that no column can, except by a combination of improbabilities, be under a truly central load. There will exist in every column some eccentricity, due partly to accidentally eccentric imposition of the load, partly to geometrical eccentricity of the column, and partly to lack of homogeneity of the material owing to the methods of its production and to the fabrication of the column. All these forms of eccentricity may, for mathematical purposes, be summed up as a single eccentricity of load.

Any number of columns supposedly identical will fail under test at widely differing loads owing to the differing amount of the virtual eccentricity. The result of this is that the locus of ultimate unit strength of columns of like material and varying length ratio is not a line but an area, and inspection of of test data shows that, barring a few scattering spots which may be put down as due to defective specimens, this area is very well defined. A sufficient number of tests are plotted in Figs. 2 and 3, to show the general nature of the area.

Practically all authorities, except Moncrieff, draw their curves through the middle of this area. Moncrieff points out that the curve defining the lower limit of the area should be taken as the real curve of ultimate strength, inasmuch as no column can safely be assumed as having an ultimate strength greater than this.

He found that a curve constructed from his formula could be made to define the lower limit of the area of failure, the upper limit, or the mean, according as the value assigned to eccentricity was a maximum, a minimum or a mean.

Moncrieff's formula for the ultimate strength of a round-end column under supposedly central but actually eccentric load is

$$\frac{l}{r}=\sqrt{\frac{48E}{5f_t+p\left(\frac{ye}{r^2}-5\right)}\left[\frac{f_t}{p}-1-\frac{ye}{r^2}\right]}$$

It will be noted that the term expressing the eccentricity occurs in combination with the radius of gyration and the distance to the extreme fiber, in the form: $\dfrac{ye}{r^2}$

It may be noted that in several other rational formulas, which deal with the eccentricity, including Prof. Johnson's, the same fraction appears and is the only form of the eccentricity function. Prof. Lilly has derived a formula in which the same eccentricity function appears, but he has discarded the eccentricity as unimportant.

By careful comparison with test data, Moncrieff evaluated this fraction. He found that its greatest value could be taken as 0.6, and its least value as 0.15, and that these can be taken as constants, irrespective of the material and type of end. In other words, for the lower limit curve the value 0.6 can be substituted for ye/r^2 in the equation, which will still be entirely general. This allows the formula to be reduced as follows:

$$\frac{l}{r}=\sqrt{\frac{9.6\,E\,(f_t-1.6\,P)}{p(f_t-0.88\,P)}}$$

This is the formula which has been used in the preparation of the Construction and Repair Tables. The terms E and f_t are constant for any given material, allowing corresponding values of p and l/r to be found without difficulty. It may be noted that, using the same value for ye/r^2, Prof. Johnson's formula may be written:

$$\frac{l}{r}=\sqrt{\frac{9.6\,E\,(f-1.6\,P)}{p\,(f-P)}}$$

These two formulas differ only in the coefficient of p in the denominator, and the difference is trifling.

Both of these formulas assume that the elastic curve of the column is a parabola. This is the only assumption made by Moncrieff, not resting on a strictly rational or experimental basis. This parabola lies between the arc of a circle of

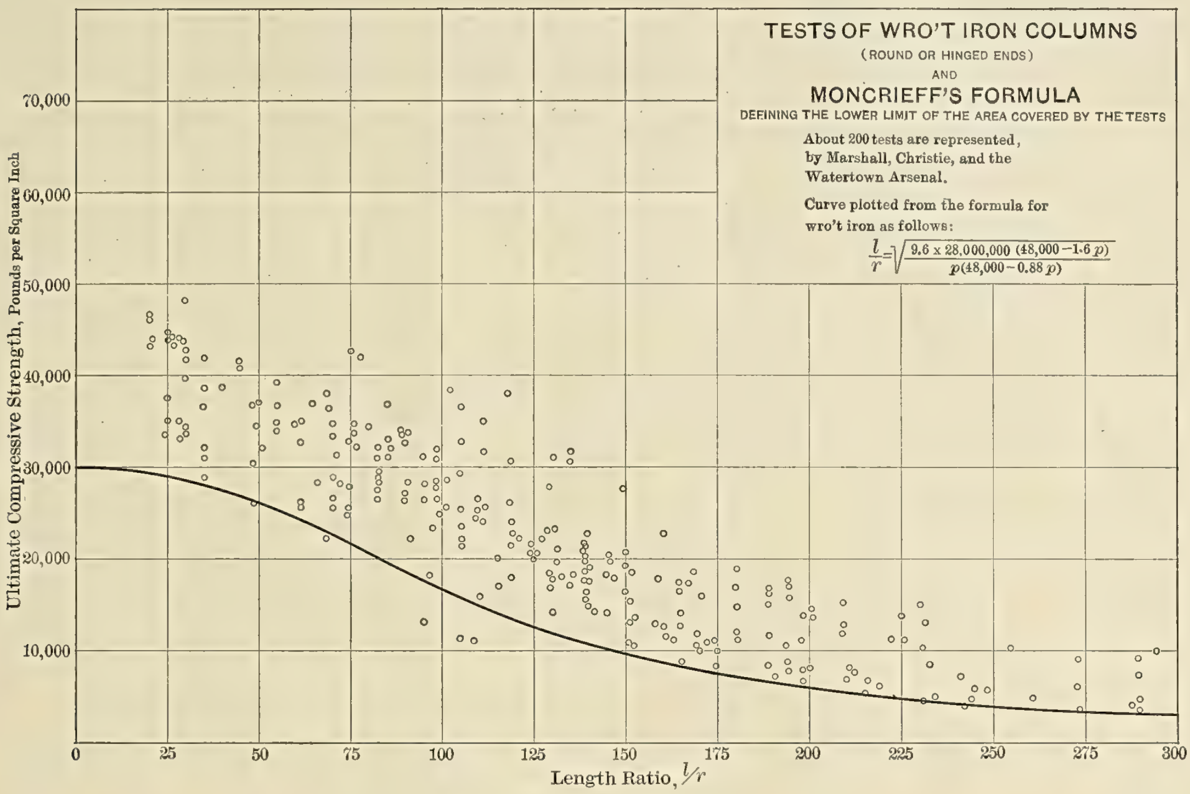


FIG. 2.

Rankine's formula and the curve of sines of Euler's. Moncrieff shows that a column must bend either to a curve of sines, to an arc of a circle, or to some curve lying between these two, and that the parabola fulfills this condition, and, as compared with either the curve of sines or the arc of a circle, involves a possible error not exceeding 2.73 percent; this error, if it exists, is on the safe side.

Since Moncrieff's formula gives the relations due to stressing the extreme fiber to a definite amount (the ultimate strength), it is true for failure by crushing on the intrados.

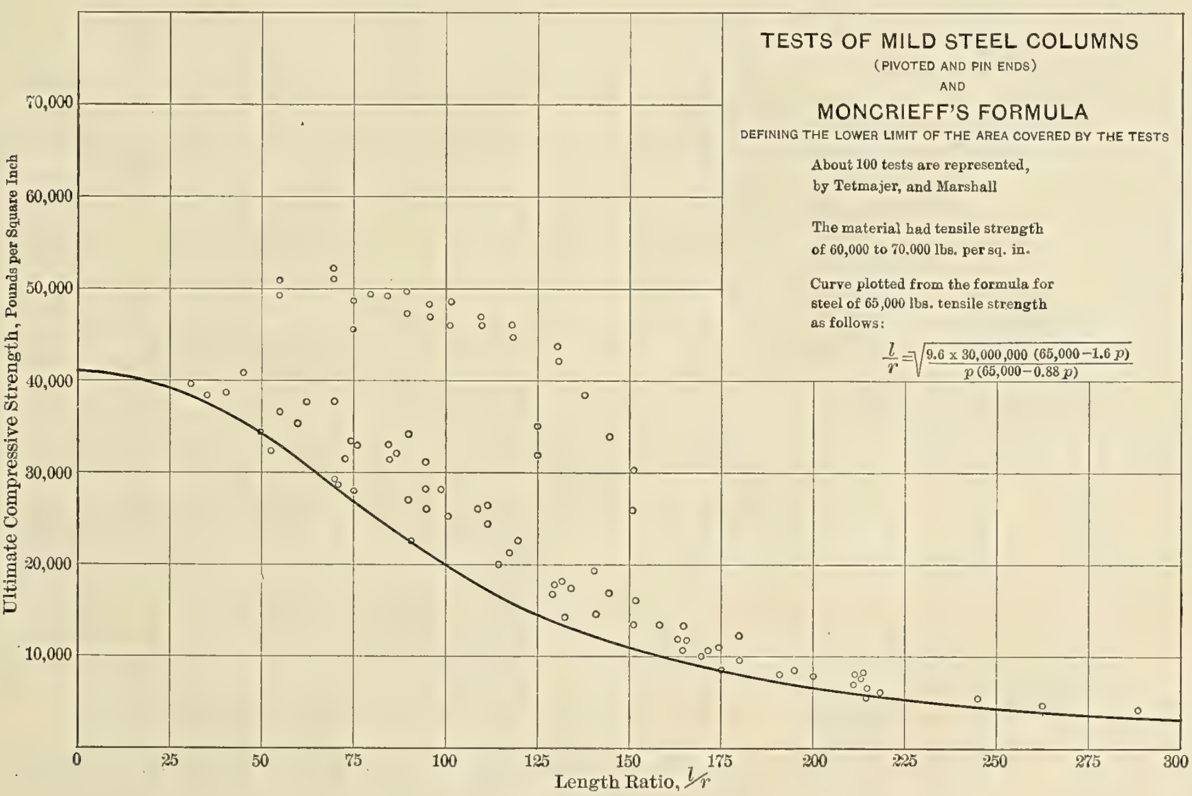


FIG. 3.

Euler's formula establishes the relation existing when the column is at the limit of elastic stability. The column will fail by crushing or by instability according to whether the load producing an ultimate crushing stress is greater or less than that causing instability. If therefore Moncrieff's and Euler's curves intersect, it would be necessary to pass from one to the other at the point of intersection, choosing the lower in each case. However, when the value 0.6 is used for the eccentricity, Moncrieff's curve is entirely below Euler's, rendering such a transition unnecessary. This point will be touched on again when dealing with factors of safety.

The value of f used by Moncrieff is the ultimate strength of the material. Prof. Johnson uses f equal to the elastic limit. A number of other authorities assign the elastic limit as the real ultimate strength. Mr. C. C. Schneider in the Quebec Bridge Report states that the real ultimate strength is the yield point or commercial elastic limit as given by the drop of the bar. There seems to be some confusion among those who hold to the elastic limit as to whether it is the load producing a stress in the extreme fiber equal to the elastic limit, or the load producing an average stress over the entire section equal to the elastic limit. None of the formulas is strictly applicable when the stress in any fiber exceeds the elastic limit. The same is true, however, of the ordinary formula for cross bending, in which case it is generally considered orthodox to use the ultimate strength of the material for the stress in the extreme fiber at failure. Tests made on very short compression specimens (l/r about 5, Tetmajer and also Marshall) show an *average* stress at failure about equal to the elastic limit. By using the ultimate strength of the material for the stress on the extreme fiber at failure, Moncrieff's formula gives an average stress at $l/r = o$, about equal to the elastic limit. Moreover, with this value for the extreme fiber stress, Moncrieff's formula fits the tests. It seems proper, therefore, to use this value.

WORKING STRESSES.

Having decided upon the most suitable formula for the ultimate strength of the column, it remains to determine the proper method of arriving at safe unit loads. Two methods present themselves: Either the value of f in Moncrieff's formula can be taken as the safe fiber stress instead of the ultimate fiber stress, and the formula thus modified be used for determining the safe average unit loads directly, or the safe loads can be obtained from the ultimate loads by applying a factor of safety, which may be either constant or variable.

The former method is that followed by Moncrieff. It gives unsatisfactory results for a reason apparently not fully appreciated by Moncrief. Eidlitz shows (Proc. Am. Soc. C. E. 1896) that the ratio between the average load and the stress on the extreme fiber cannot be constant, a fact also evident from Moncrieff's formula. The reasoning is as follows:

Let p = the unit ultimate average load and
f_c = crushing strength of the material;

then, if the direct load is deducted from the maximum there remains for the bending stress $f_c - p$.

Now if θ be the deflection, m the section modulus and a the area,

then $$\frac{1}{m}\theta p a = f_c - p$$

$$fc = p\left(1 + \frac{1}{m}\theta a\right)$$

Similarly for some other stress f, less than f_c, we have $p_1 < p$ and $\theta_1 < \theta$,

and $$f = p_1\left(1 + \frac{1}{m}\theta_1 a\right)$$

Now f/f_c can vary as p_1/p only when $\theta = \theta_1$; hence the condition is impossible; that is, *the stress in the extreme fiber does not vary in direct proportion to the direct load*, from which Eidlitz concludes that the safe average unit load should be proportioned to the fiber stress. By carrying the reasoning a little farther, however, a quite different conclusion is arrived at.

Putting $n f = f_c$ and $k p_1 = p$, where n and k are constants, we have for the ratios of loads and stresses:

$$\frac{f}{nf} = \frac{p_1\left(1 + \frac{1}{m}\theta_1 a\right)}{k P_1\left(1 + \frac{1}{m}\theta a\right)}$$

from which it is evident that with $\theta_1 < \theta$, k must be less than n, or, in other words, a factor of safety of, say, 3, with reference to the extreme fiber stress, will provide a factor of safety of less than 3, with reference to the total load.

As an illustration of his method of arriving at a working formula, Moncrieff takes the case of mild steel, taking E = 30,000,000, and f = 24,000 pounds per square inch as a safe stress in the extreme fiber. He plots this curve, and also Euler's curve, the latter with a safety factor of 3, and finds that the two curves intersect at $l/r = 88$. Now in comparison with his curve for ultimate strength, his working stress curve has, at $l/r = 1$, an average safe load equal to 3/8 of the ultimate, or a true factor of safety of 2 2/3, while, at $l/r = 88$, his working stress curve has an average safe load equal to 3/5 of the ultimate, or a true factor of safety of only 1 2/3. Concerning this, Moncrieff says: "The writer thinks that, like himself, other engineers would hesitate to adopt heavier loads, in relation to ultimate strength for a column 89 or 90 radii long, than would be considered safe for columns only one-quarter of the length." He therefore applies to E in his formula a factor which has the effect of decreasing the average load, as l/r increases relatively to the average load given by the unaltered formula. His formula thus modified gives a more logical factor of safety, but has lost its rationality and has become empirical. The method of arriving at a safe average load by reference to a safe extreme fiber stress is thus evidently incorrect.

The second method cited, namely, that of applying a factor of safety to the average load, as given by the formula for ultimate strength, is, therefore, the method to be used. The question is as to how this factor of safety should be determined. Prof. Johnson, in arriving at a working formula, so arranges his formula that the factor of safety will decrease as l/r increases. He bases this upon the fact that the effect of the eccentricity decreases as l/r increases, and as the eccentricity is contained in his working formula only in the shape of a factor of safety, this is undoubtedly a reasonable provision. The Pencoyd tables, on the other hand, provide for an increasing factor of safety with increasing l/r, "owing to the greater inability of the long struts to resist cross strains, etc." In the case of Moncrieff's formula, as the effect of the eccentricity has been discounted by using the curve defining the lower limit of failure, i. e., the upper limit of eccentricity, the reasoning leading to Prof. Johnson's decreasing factor of safety does not apply, nor does there seem to be sufficient force in the Pencoyd assertion to warrant an increasing factor, except, possibly, in special cases. The factor of safety was therefore kept constant for varying values of l/r.

Now it is becoming pretty generally recognized that, although the nominal factor of safety of a tension member may, for convenience, be based upon the ultimate strength of the material, the true factor of safety is the ratio of the working stress to the elastic limit. The elastic limits in compression and in tension being practically equal (except in the cases of

cast iron and timber), and it having been pretty well proven experimentally, as noted above, that columns having a length ratio of 5 (i. e., practically 0) fail at an average load equal to the elastic limit, if a factor of safety be applied to the curve of ultimate strength such that the average load at $l/r = 0$ will become the same as the allowable tensile stress, the true factors of safety for tension and for compression members will be practically equal. In other words, if it be determined for any structure composed in part of tension members and in part of compression that a certain safe stress, say 15,000 pounds per square inch, should be allowed for the tension members, then the compression members should be proportioned from a curve which gives a value of 15,000 pounds for the average unit load at $l/r = 0$, and the structure, when so proportioned, will have equal strength throughout.

In the preparation of the Construction and Repair column tables, the method followed was first to set up the curve of ultimate column strength for the given material from the formula; second, to divide the ultimate tensile strength of the material (f_t) by the nominal factor of safety; third, to find the ratio of this quotient to the ultimate column strength at $l/r = 0$, which gave the "true factor of safety," and, finally, to apply this true factor of safety to the values read from the curve, the results being the safe average unit loads corresponding to that nominal factor of safety. Inspection of our formula shows that the ratio of the true factor of safety to the nominal factor, when derived in this manner, is as 1 is to 1.6; for convenience, the true factor may be taken as six-tenths of the nominal factor. This ratio is, as stated, practically the same as the ratio of the elastic limit to the ultimate tensile strength, for most engineering materials.

It should be added that the value of the ratio $\dfrac{\textit{ultimate unit load}}{\textit{safe unit load}}$ is properly less when the ultimate load is based on Moncrieff's formula than when it is based on a formula intended to average the results of experiments, the difference between Moncrieff's formula and others being due to the definitely allowed-for eccentricity, which in the case of the averaging formulas has to be covered by an additional factor of safety, which is in this case truly a factor of ignorance.

FIXED, FLAT AND PIN ENDS.

So far consideration has been given only to the theoretically round-ended column, which is incapable of taking any bending moment at the ends, although it should be noted that the assumption of a parabola made by Moncrieff for the elastic curve carries with it the existence of a small moment at the ends.

If a column be rigidly fixed at the ends, the strength of the column will be the same as that of a column of equal section and half the length. If a column have flat ends, bearing upon surfaces rigidly held parallel, it will have the same strength as a fixed end column of equal length and section, unless the conditions of bending are such as to develop tension on the extrados. (Moncrieff's formula can be arranged to express this condition.) If a column receive its load through pins at the ends, some friction will occur in the pins, which will impose some bending moment at the ends of the column and so make it stronger than one incapable of taking any bending moment at the ends. Moreover, if the pins be held rigidly by the adjoining structure, the column is fixed ended in one plane, while pin ended in the other.

The asumptions with regard to fixed and flat ended columns are, however, never realized in practice. The degree of fixity of the end will depend on the rigidity of the part to which it is fixed and on the deflections to which this part may be subject. Any deflection in a member to which a column is fixed sets up secondary stresses in the column. There exist methods for calculating these secondary stresses, and in large and important work they can be taken into account and quantitatively allowed for. In the case of the class of work for which the shipwork tables will be principally used there is no likelihood that secondary stresses will be calculated and the probability is that their presence will generally be unthought of.

Moncrieff states, after discussing the difficulties as to fixing the ends of columns, "the estimation of this degree of fixity demands the most careful consideration on the part of the engineer." Mr. C. C. Schneider (Quebec Bridge Report) says: "For compression members, with hinged ends, the friction of the hinges should be entirely neglected, and even for compression members with riveted, and, therefore, partly fixed ends, the free buckling length should not be assumed less than the distance between connections on account of the secondary strains due to the elastic deformation of the truss. These secondary strains may . . . . partly or entirely counteract the fixity of the ends."

It appeared, therefore, that for the purposes of the Construction and Repair tables, and having in view the class of work upon which they will be used, no distinction should be made between the different types of ends, and a single set of tables, based upon the round-end column, should be used regardless of any fixity of the ends. It seemed proper, however, in the case of a pin-ended column to use the radius of gyration corresponding to the probable direction of flexure, that is, the radius of gyration which lies in a plane normal to the plane of the pin. However, as the most favorable effect of fixity of ends possible would be to halve the column length, and hence to halve the value of l/r, it is permissible in such cases to use the greater radius of gyration only when it does not exceed twice the least radius of gyration.

The tests so far made at the Watertown Arsenal, in accordance with the programme laid down by the American Society for Testing Materials, show no advantage for fixed or flat ends over round and pin ends ("Engineering News," Aug. 26, 1909, and Proceedings American Society for Testing Materials, volume 8, page 336). This may have been due to lack of straightness in the specimens and to other causes, and is not borne out by the experiments of others, but the conclusion that "centrally applied or axial loads may be sustained with equal success without regard to the type of end bearing" may, nevertheless, be considered as a practical one.

(To be concluded.)

METALLIC LIFE-BOATS.

In the construction and maintenance of ships there is probably no problem which causes more vexation and annoyance than the question of properly equipping the vessels with life-boats, as prescribed by law. As a rule, the naval constructors and architects do not waste much time on the lifeboat question, but simply enter in their specifications: "Lifeboats to be in accordance with the law," and in the United States that means—in accordance with the rules of the Steamboat Inspectors. This leaves it entirely in the hands of the shipyard to comply with said rules, and, naturally, the cheapest equipment which can be considered as complying with the law is chosen; the representative of the shipowners should, of course, see that this equipment is of the most modern type, but unless the specifications call for certain stipulated requirements over and beyond what the law actually requires it is a very difficult matter to induce a shipbuilder to furnish other than the very cheapest boats.

With regard to boats there is a very wide scale of a difference between the cheapest and the best, and even a wider difference of opinion. In the United States metallic life boats

have for years been considered the most desirable; there are, however, still some exceptional cases where owners' representatives insist on having wooden boats. In European ships wooden boats are mostly used, and there seems to be a certain sense of security for the layman in the fact that the boat is of wood, since wood will always float, while iron or steel will sink.

It is certain that wooden boats require constant attention, especially on ships which cruise in many latitudes and are subjected to varying atmospheric conditions, for even well-seasoned material will check and shrink under such conditions. From exposure to heat or cold all wood will expand or contract, and therefore wooden boats have to be constantly looked after, calked and painted, etc., in order to be in seaworthy condition should occasion arise to use them.

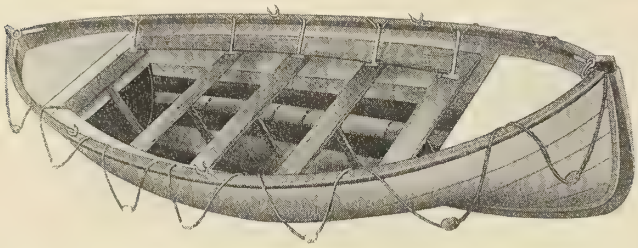


Fig. 1.—Type of Metallic Lifeboat Used in the United States.

This trouble is almost entirely eliminated in metallic boats. Whereas steel will also expand and contract somewhat, accordingly as exposed to heat or cold, still this action is so slight that it does not affect the tightness of the boat's seams at all. Besides, they do not need as many coats of paint and the calking need not be renewed periodically. Another advantage of metallic boats is that they are, as a rule, much lighter than wooden boats.

In Europe the metallic boats used are made of pressed steel; the two halves of the boat being shaped and joined at stem, stern and keel. These boats enjoyed a certain degree of popularity for a time; but corrosion soon set in, particularly where the wooden gunwale and molding was attached. The concerns who installed such boats, therefore, found it necessary to remove the gunwales, etc., about once a year in order to repaint the metal and so protect it against rusting, but this procedure made the up-keep of pressed-steel boats rather expensive. Moreover, these metallic boats are considerably heavier than the ordinary wooden boat, whether built lapstreak or smooth, and this may account for the predominance of wooden boats on European ships.

The metallic boat referred to, which is lighter than one of wooden construction, is the type of metallic boat built in the United States. Here galvanized sheet metal is attached in longitudinal strakes (with flannel between the seams) to oak keel, stem and sternpost; the seams are riveted with countersunk rivets, thereby insuring a smooth surface. Owing to the additional stiffness given by the lapped seams, where the metal is double, it was found possible to use a comparatively light gage of metal, and therefore boats so constructed have only about half the weight of the ordinary wooden life-boat, and yet they are very strong and durable. One of the greatest advantages of such a metallic life-boat is the little up-keep required. As all the metal is galvanized—not only on the outer and inner surface but in the seams and wherever wood is attached—it withstands corrosion for a long time.

Boat builders, who are often called upon to repair old life-boats of both wood and steel, have a splendid opportunity to secure considerable data as to the comparative strength and durability of wooden and steel boats, and from them we learn that, although more steel boats than wooden ones are in use in the United States, it is a fact that they are more often required to repair wooden boats than metallic. During the hurricane season, when ships often come to port with their boats more or less damaged, it is invariably found that a wooden boat has been smashed beyond repair, whereas a metallic boat may have only a few small dents which are readily repaired without much expense or loss of time. Figs. 2 and 3 show a couple of boats which were on board a ship which ran ashore last year. The boats were used for transferring passengers to another ship, and during the transfer were pretty badly smashed, as the large dents will show; nevertheless, and in spite of the tremendous bulges, the boats were perfectly serviceable and tight and served their purpose admirably at the time. To anyone familiar with boats it will at once be apparent, on seeing the dents and bulges, that a wooden boat under the same conditions would have been splintered to kindling.

Regarding the durability of the type of metallic boat used in the United States, it has been found, when undertaking repair jobs on boats which had been in use for twenty years or more, that when the molding was lifted off at the gunwale, the galvanizing and the metal were perfectly intact. In spite of this there are still a good many who fear that corrosion and rust may have made the boats unfit for use when they are

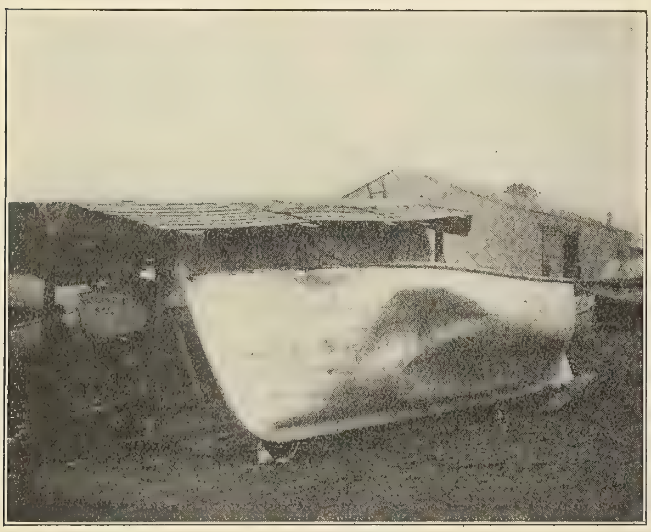


Fig. 2.

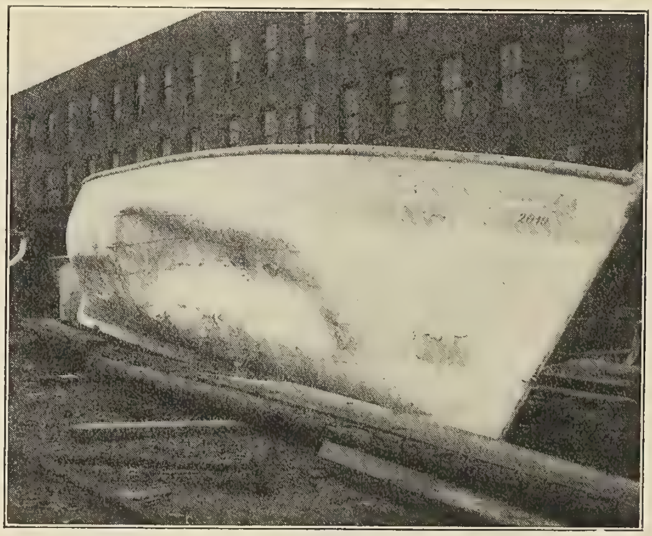


Fig. 3.

most needed, and this prejudiced element prefers to pay practically twice as much for a wooden life-boat. During the last year or so, therefore, attempts have been made to build life-boats of non-corroding material, and it has been found that life-boats built of sheet bronze, reinforced with oak ribs and stringers closely spaced, afford a satisfactory construction which combines the advantage of the metallic boat as above set forth with the more or less imaginary advantages of the wooden boat, viz.: no rot or leakage, etc.

These bronze boats are built in the same way as the ordinary metallic boat as regards the riveting, lapping of seams, etc., with the exception that the wooden ribs are inserted after the boat has been shaped on the mold and riveted up. These ribs are steam-bent and attached to the metal shell by means

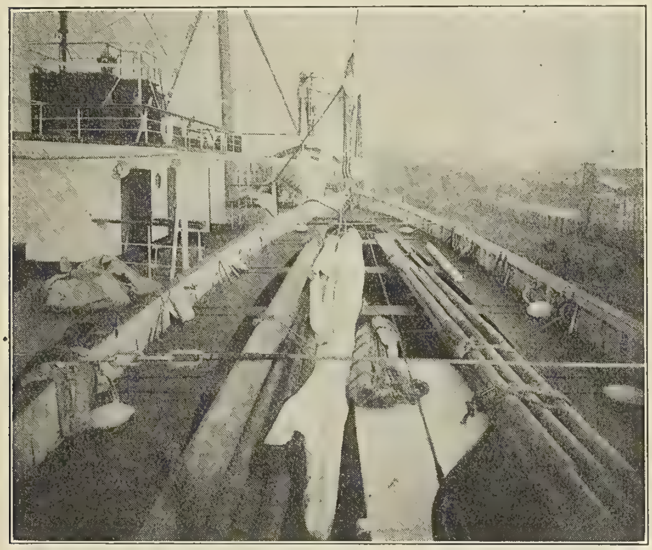


FIG. 4.

of U-shaped clips passing over the ribs and riveted to the plating, so that all riveting is metal to metal and all danger of leakage is obviated. The cost of a bronze boat is about 10 to 15 percent more than that of a first-class wooden boat, but the lasting qualities of bronze boats apparently more than compensate for the slightly increased cost, and, moreover, such boats require practically no up-keep.

In the up-keep and preservation of life-boats, it is generally not only the structural details that have to be taken into consideration, but also the way they are placed and chocked on deck, and secured by gripes and covers, etc.

As regards the chocking and griping of the boats, it is not always so very easily done nowadays when we first consider that as much deck space as possible should be saved and also that attention is more and more drawn to the readiness of having them quickly launched. Of course, as far as launching is concerned, the davit arrangement forms the principal part, but outside of this a great deal of time can be saved by improving the releasing of the gripes and the chocks. In the old-fashioned way of griping boats Pelican hooks are generally used which are often clogged up with rust or paint, and unless the lanyards are of rope and can be quickly cut away it naturally takes quite some time to release the same. Besides the gripes being extended with clamps from the gunwale on each side to the deck, it is necessary for one man to go outside the boat to release the gripe on that side, and in stormy weather this procedure may be somewhat risky; also in a very high sea, when shipping great quantities of water, it sometimes happens that the covers are smashed in and the boat is filled with water, and the tension of the gripes from the gunwale on each side often helps in damaging the boat, and in some cases splits it open fore and aft.

For this reason the continuous gripe arrangement shown in Figs. 4 and 5 has been developed. This continuous gripe arrangement has two decided advantages. One is that it is automatically released at the same time the chocks are being released, and the other is that if the vessel should ship great quantities of water in a very heavy sea, it would tend to hold the boat together instead of splitting it apart, and, above all, it would also hold the boat down to the deck in any condition that may arise.

There are a good many questions regarding life-boats, and particularly regarding those built in the United States, which might be considered, but, as stated before, there are about as many different opinions on this subject as there are authorities, and probably for this reason most people are satisfied so long as the life-boats conform to the rules laid down by the U. S. Steamboat Inspection Service. Conformity to these rules would seem to indicate uniformity of construction, but such is not the case. The various inspection districts interpret the rules in different ways; for instance, some insist on having the tanks built into the boat and others want independent tanks; still others want all the lower woodwork, such as keel, stem and sternpost covered with sheet metal, and some

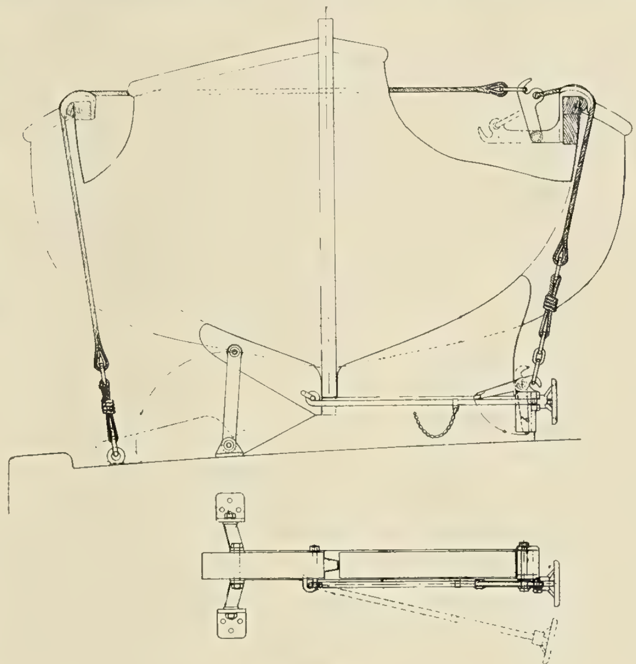


FIG. 5.

want it bare. Although the laws laid down by the Government for the Steamboat Inspection Service are supposed to be the same as those by which the various inspectors are guided, yet there seems to be a wide margin for the personal opinion of the individual, and, owing to the different construction put upon such laws by the various inspectors, owners and captains of steamboats experience considerable annoyance and expense when their ships are inspected in different districts, for although their boats may be in compliance with the requirements of the one, certain changes may be necessary to satisfy the other.

The Bureau of Navigation reports 82 sail and steam vessels of 14,375 gross tons were built in the United States and officially numbered during the month of October, 1910. Six steel steamers of 11,686 gross tons were built on the Atlantic Coast.

EIGHTEENTH ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The eighteenth annual meeting of the Society of Naval Architects and Marine Engineers was held in the Engineering Societies building, New York, November 17 and 18, 1910. According to the report of the secretary-treasurer fifty-five new members were elected during the year and thirty-nine were elected at the present meeting. The total receipts for the year were $10,715.67 (£2,680), and the total disbursements, $10,797.65 (£2,700).

PAPERS READ NOVEMBER 17.

No. 1—Notes on the Armaments of Battleships.

BY SIR WILLIAM H. WHITE, K. C. B.

(This paper is published in full on page 497.)

No. 2—Evolution of Screw Propulsion in the United States.

BY CHARLES H. CRAMP.

PART II.

ABSTRACT.

The period of the greatest activity in shipbuilding in this country, as far as the hulls were concerned, which were all of wood, was between 1849 and 1860, and it was about that time that iron had begun to take the place of wood in Great Britain. It was at the close of the demand for a high class of vessels, which originated during the famine in Ireland, that gold was discovered in California. This necessitated quick transportation for trade and travel, and the great American clipper, which had been introduced in the East India trade, had developed into the highest state of perfection ever attained in the art. The investment due to the favorable conditions of the time was a correspondingly profitable one. This might also be said of certain paddle-wheel steamers that began to make their appearance about the same period.

Both of these classes of ships, particularly as far as the hulls are concerned, were by all means the greatest and most interesting specimens of naval architecture that the world has ever witnessed; not only as traders, but for the beauty and gracefulness of their design, completeness of their equipment and seaworthiness.

The great character and high standing of these ships, with all relating to them, began in 1853 to lose that important position they had acquired before that time. The building of the *New Ironsides, Monitor* and *Galena* was an event that led to the effectual and final destruction in this country of the great shipbuilder whose career and occupation had been so distinguished in connection with the great packet and clipper, and had covered him with so much glory.

Having been convinced at an early date that we should take up iron shipbuilding, we commenced in it by building the side-wheel tow-boat *Lehigh* to take the place of the old boat of the same name. Previous to 1847 all towing was done by the paddle-wheel boat, mostly by old ferry-boats; these were to be found everywhere in the United States and Cuba, but at an early date we built the screw tug *Sampson*, which was the first screw tug-boat built in this country. Later on we built the *George W. Clyde*, the first ship built in this country with fore-and-aft compound engines.

The success of the experiment on the *George W. Clyde* was greater than we expected, and we concluded to build compound engines and not consider any other type in our business as builders of complete steamships.

The building of the *Pennsylvania, Ohio, Illinois* and *Indiana*, between 1873 and 1874, was an event of much importance, particularly as the ships were propelled by screws and the engines were of the John Elder type of compound engines. The ships were subjects of much consideration on their arrival in Liverpool, many of the principal shops sending their draughtsmen to look up the flanging in the boiler heads and fire-boxes of the boilers; no flanging of these or any other part of a boiler had been done before in Great Britain. They also took some trouble to examine the white metal in the bearings of these ships.

No. 3—The History and Economic Value of Canals, with Special Reference to the Cape Cod Canal.

BY COMMODORE J. W. MILLER.

ABSTRACT.

From a casual study of the history of canals two facts present themselves:

1. That a congested and interior population naturally seeks the sea for wider markets.

2. That wherever practicable traffic will ultimately reach the sea by water, which has been, and again will be, the cheapest of all routes.

The truth of these axioms is to be seen from remotest time.

From an engineering point of view, the problem of constructing the Cape Cod Canal is not great. The total length over the isthmus is 8 miles. The total length to 30-feet depth in both bays is 13 miles. The soil to be cut is sand, and amounts to 17,000,000 cubic yards. The deepest cut is 29 feet above tide-water. The channel at both ends of the route, the natural marshes and streams already furnish a waterway for boats of light draft. The difference in tide between the two bays necessitates no locks. The depth of the canal is to be 25 feet. Minimum width of bottom 100 feet through the central portion of the canal; this will give a surface width at the narrowest point of 250 feet. The approaches will have a minimum bottom width of 250 feet. The right of way has been obtained, and in addition other tracts of land essential to the undertaking.

Agreements for the change of the railroad line have been made with the N. Y., N. H. & H. R. R. Co.; the railroad bridge necessitated thereby is completed; four dredges are deepening the 5-mile western approach from Buzzards Bay; two large suction dredges are removing about 20,000 cubic yards per day for the channel through the marshes at the eastern end of the canal.

A breakwater, 3,000 feet in length, is being built to the northward of the channel, where it enters Barnstable Bay. Several other dredges are at work on the central portion of the line. Administration and other buildings have been bought and the necessary preparation made for a campaign of activity on the ground during the coming winter.

The bridges are being constructed on the basis of an ultimate depth of canal of 34 feet. They will each have an opening of 160-feet span of the type known as the Bascule lift bridge. The local travel across the canal will be accommodated by such bridges or ferries as experience may dictate.

The final estimates for the canal include the thorough electric lighting and other aids to navigation of the whole channel and approaches requisite for a region where fog prevails.

The tonnage through Vineyard Haven Sound to-day, which will be all tributary to the canal, amounts to 25,000,000, of which there is:

Coal	9,000,000 tons
Stone	300,000 tons
Nova Scotia plaster	250,000 tons
Oil	200,000 tons
High-class merchandise	2,000,000 tons

the remainder being crude material of various descriptions.

The number of passengers between New York, southern and eastern points, by water is to-day over 500,000. This amount

will be greatly increased through the opening of the canal, as the neighboring regions will be much more accessible, and steamers of the Sound type can leave New York late in the evening, land their passengers at desirable resorts, and arrive at Boston early the next morning.

The N. Y., N. H. & H. R. R. Co. runs along the southern bank of the canal. A large manufacturing center will be developed at the eastern end, where mills will have the advantage of both land and sea transportation. Water abounds in the hills back of the center of the line, and on these hills an increasing summer population will undoubtedly be settled.

Skepticism as to the success of the canal has been natural, being based on the conditions of the past, when the great majority of the coastwise tonnage was carried in sailing vessels.

To-day—

(*a*) This tonnage is under the control of a small number of corporations, which tow the merchandise in barges containing from 1,000 to 3,500 tons.

(*b*) The towing companies now require a plant for a three-weeks' round trip on account of the dangers and delays via Vineyard Haven route.

(*c*) The cost of this plant will be reduced at least one-third, for the reason that not only is the distance shortened sixty-six miles, but the duration of the trip is greatly diminished.

(*d*) Insurance from perils of the sea will be lessened.

(*e*) The congested railroad systems of the Atlantic Coast are now heartily in favor of water transportation for crude material, thus relieving their lines for the transportation of high-class merchandise and passengers.

(*f*) This new waterway is not in the strictest sense a canal, but a short passage connecting two portions of a much-traveled route through which a known traffic exists. Its conditions are analogous to those at Suez, where the profits have far exceeded the estimates.

(*g*) Humanity demands the elimination of the dangerous, stormy and fog-bound route around the Cape. The loss of life and property in that locality has been appalling. The record, more or less incomplete, from 1843 to 1903, gives a minimum of 2,131 vessels wrecked in the Nantucket Shoals region, 908 of which were a total loss. Ten complete crews disappeared with their ships, and in addition, about 700 men lost their lives.

The completion of the canal will render unnecessary the proposed dredging of Pollock Rip channel at an estimated cost of some three million dollars, a sum which could be much more advantageously used by the Government in the neighborhood of the canal rather than being wasted in the tortuous and ever-shifting channels off Chatham.

No 4—Coaling Warships—Notes of Progress.

BY SPENCER MILLER.

ABSTRACT.

One of the United States colliers (purchased during the Spanish-American war) discharged with its own gear from its four hatches 1,200 tons of coal in ten hours, 120 tons per hour, or 30 tons per hour per hatch. About 100 men were required to fill the coal bags in the hold. For a single hour 50 tons of coal per hatch may be discharged.

In contrast to this the United States navy collier *Hector* discharged 190 tons of coal from one hatch in one hour, employing a self-filling bucket operated by two men. This means a great saving in manual labor as well as a saving of time. In time of war the importance of reducing the labor of coaling is apparent to everybody.

The United States Navy Department began a few years ago to build colliers from their own designs or prescribed characteristics. The first two were the fleet colliers *Vestal* and *Prometheus*, both 16-knot ships, carrying 6,400 tons of coal each. Next were the *Mars, Vulcan* and *Hector*, sister ships, with 12 knots speed and 7,200 tons carrying capacity. The colliers *Cyclops* and *Neptune*, now under construction, will have 14 knots speed and carry 12,500 tons of coal each. All of these colliers, excepting the *Cyclops*, carry a novel form of coal-discharging gear known as the Marine Transfer. The *Cyclops* will discharge its coal by self-filling buckets, but with a different system of rope leads not at present known by the author.

The Marine Transfer on the colliers *Mars, Vulcan* and *Hector* comprises the winches and a novel form of rope lead with blocks and ropes to operate a self-filling bucket for discharging coal from a collier. The masts and booms on these three colliers are cheaper than on the *Vestal* and *Prometheus*, but they are less favorable to the operation of the Marine Transfer. A far greater amount of coal can be taken out of these colliers with the clamshell bucket before trimming is necessary than is possible on the *Vestal*. The operation of the bucket is practically the same on all the colliers.

In the official coaling trials discharging into a barge and using the large bucket:

The *Mars* handled 137 bucket-loads, aggregating 117 tons.
The *Vulcan* handled 155 bucket-loads, aggregating 180 tons.
The *Hector* handled 175 bucket-loads, aggregating 190 tons.

Ordinary seamen on board these colliers were drilled to operate the Marine Transfers with the clamshell buckets, from which it has been established that two fairly intelligent men require about eight hours to become sufficiently proficient to be capable of discharging 100 tons of coal per hour per hatch. One hundred and ninety tons of coal per hour per hatch can be discharged at any time with winchmen of sufficient skill and practice.

The author believes that the maximum efficiency in coaling will be attained by employing clamshell buckets delivering coal in bulk directly into bunkers when possible and when impossible into hoppers on the deck of the ship to be coaled, such hoppers to be arranged so that trucks holding about 1 ton of coal can be pushed beneath the hopper and filled therefrom by the movement of a valve or gate, the coal then to be trucked to various parts of the deck, where it can be dumped through coal chutes to the bunkers. Such a method will reduce the number of men involved to a minimum. It would save the cost of coal bags or baskets. It will save the fatigue of the sailors in shoveling coal and carrying baskets or the dragging of bags of coal on the deck. The author believes that coaling with bags will gradually give way to coaling in bulk, and a great saving in the cost of bags will then accrue to the navy

There are three important points involved in the design and construction of the Marine Transfer winches:

1. The employment of flat metallic slipping frictions with air-cooling passages.

2. The employment of a lever control, which makes the operation comparatively easy.

3. The position of the operator is such that he can see the bucket in all parts of the hold as well as in every position it might take above the hatch.

The metallic slip frictions on all of these colliers involve the use of an extra hard steel plate attached to the gear and the employment of friction blocks made of a special composition. Wire seems to be the only material of which to make the ropes properly.

No. 5—Floating Dry Docks in the United States; Relative Value of Wood and Steel for Their Construction.

BY WILLIAM T. DONNELLY.

ABSTRACT.

The building of timber floating drydocks in the United

States is very old, and there are now in use in the port of New York sixty-four floating drydocks, all of wood, ranging in tonnage from 400 to 12,000 tons, and in the United States there are ninety-one floating drydocks, three of steel and one with steel wings, ranging in tonnage from 200 tons to 18,000 tons, having a total tonnage of 228,800 tons and an average tonnage of 2,500 tons.

The only steel commercial floating drydock is at the works of the Great Lakes Shipbuilding Company, Detroit, Mich. The only other steel floating drydocks in use in the United States are the Algiers dock opposite New Orleans, La., and the steel dock taken by the United States government from Havana during the Spanish war, now in Pensacola, Fla. The Detroit dock and the Algiers dock are in fresh water, which makes their preservation much easier.

All the writer's experience with floating drydocks and their construction and repair leads to the firm conclusion that for underwater work, such as pontoons for the Rennie type of dock, wood is a much superior material of construction to steel, that the original cost is much less, the cost of maintenance less, and the life of the structure greater than steel. For the wings and upper work, experience is equally conclusive for the use of steel. While it is apparent that the cost of maintenance will be considerable, the structure will last much longer, and, with a sectional pontoon dock, where the wings are accessible at any time and any portion of the wings may be entirely replaced if necessary, it would seem that the structure as a whole will last indefinitely.

So far as the writer is able to judge by a somewhat limited experience, the only reliable protection for interior steel work of floating drydocks in salt water is bitumastic compound, but the first cost of this protection is very great, being in the neighborhood of $6 per ton of steel for interior protection only.

A comparison of the materials used for wooden and steel pontoons shows that the weight of the steel per hundred tons of lifting power is 33 tons, and the weight of wood per hundred tons of lifting power is 36 tons. It is evident that the difference in weight must be supplied by increased dimensions of the wooden pontoons. Other than in this particular, wood appears to have the advantage in every way.

While reference has been made to a pontoon dock of 7,000 tons lifting capacity, there does not seem to be any engineering limit to the size to which the Rennie type of dock can be built with wooden pontoons. A carefully worked-out pontoon for a 20,000-ton dock shows dimensions of 130 feet by 44 feet by 15 feet, and it will be readily understood that this structure is well within the practical limits for timber work.

Regarding the cost of the different types of floating drydocks, it is, of course, not possible to make any definite statements, as they are much influenced by the varying cost of material and the location where the dock is to be constructed. For the relative cost of the different types of docks on the eastern coast of the United States, the following figures may be taken as being approximately correct:

COST PER TON OF LIFTING POWER.

	Per Ton.
Balance sectional timber dock with centrifugal pumps..	$32.00
All-wood pontoon dock with continuous wings........	35.00
Pontooon dock, steel wings and wooden pontoons......	42.00
All-steel pontoon dock..............................	57.00
Government steel dock, Dewey type..................	62.00

The comparative cost for the western coast of the United States will be quite different on account of the increased cost of steel and the much lower cost of timber.

The paper also contains descriptions of various types of floating drydocks with both wood and steel pontoons, and also valuable reference to existing data on the subject.

No. 6—Our Constitutional Shipping Policy and the Compact for its Establishment.

BY WILLIAM W. BATES.

ABSTRACT.

In 1787, a National convention, composed of delegates from all the States except Rhode Island, met, considered and completed the Federal Constitution. The only discussion of the power to "regulate commerce" was in connection with its use for the encouragement of the merchant marine, in which the question was on a resolution that bills for "navigation laws" should receive a "two-thirds vote." This was decided in the negative, and the necessary clause was afterwards agreed to unanimously.

It should be understood that all the powers of the Constitution are derived from the States, and were given up by them and taken over by the Federal Government, not for ornament or to be laid aside, but for actual use—for the advantage and benefit of the Nation forever. The "suspension" of ship protection, or of any other promise, is a violation of compact.

It seems to be supposed by many that Congress may enact laws regardless of the Constitution, and that this charter, given by the States and the people, cuts little figure at Washington. But this is a sad mistake. That we have a constitutional shipping policy extant to-day is no wonder at all. The several States, as we have seen, had a policy of trade regulations, and thought it vital to their commercial independence. They turned this policy over to the United States, the only object being to increase its efficiency, and to get a great Nation to enforce it forever. By this compact the States were relieved of their natural duty to encourage and protect a most important industry, and the United States, by virtue of it, promised and undertook the duty, with no right reserved ever to discontinue it.

Nevertheless, this solemn compact was violated by Congress. At the height of our marine prosperity, in 1826, when our vessels were carrying 95 percent of imports and 89.6 percent of exports in our own commerce, the President recommended the "suspension" of ship protection in the foreign trade.

There was no reason of State for this act. No nation was demanding it. Under its operation for the past forty-five years, with scarcely any protection, our foreign-trade marine has almost disappeared. The different States cannot, as formerly, protect their shipping; and the Federal Government has "suspended" its law for so doing. More than this, Congress has no other way to relieve the situation than to terminate our shipping conventions and to resume vessel encouragement where it was thrown off, beginning in 1828. In other words, the Federal Government has no other course than to resume the observance of the compact and policy of the Union and the Constitution. Moreover, to clinch the argument, the Constitution having provided for a specific method of encouragement and protection (that of trade regulations, meaning "discriminating duties of tonnage and impost"), all other methods are thereby precluded; while there is no authority for the taxation that would be necessary for the fostering of the marine by subsidizing, were that method adopted.

PAPERS READ NOVEMBER 18.

No. 7—An Analysis of Tests of Water-Tight Bulkheads, with Practical Rules and Tables for their Construction.

BY PROF. WILLIAM HOVGAARD.

ABSTRACT.

This paper is a continuation of last year's paper on the "Strength of Water-Tight Bulkheads." While that paper was of a purely theoretical nature, the present paper contains an

analysis of bulkhead tests, followed by practical rules and tables based on this analysis.

The tests here analyzed were carried out on bulkheads of rectangular form stiffened by a system of vertical, equidistant stiffeners of uniform section. This system is used in several navies, it has recently been adopted by Lloyds and Veritas, and has been used for some time by several other classification societies; it is therefore of greater interest and importance than any other system of stiffening. The tests fall in two classes—those where the stiffeners are double, *i. e.*, placed on both sides of the bulkhead, and those where the stiffeners are single, or on one side of the bulkhead only.

The total number of analyzed tests is fourteen, of which six were with double stiffeners, eight with single stiffeners; but several of these tests were made at two or more heads of water. The main results are given in tabular form in the paper, and after analyzing them the author gives a resumé in the form of the following rules, which apply only to ordinary water-tight bulkheads, not to deep tank or to oil-tight bulkheads:

1. A pure system of uniformly spaced vertical stiffeners and horizontal strakes of plating should be used, except where the horizontal extension of the bulkhead is smaller than its height, and where at the same time the brackets of horizontal stiffeners can obtain a rigid attachment, in which case a pure system of horizontal stiffeners should be used. This last condition is fulfilled only in few cases, such as in collision bulkheads. In the majority of bulkheads vertical stiffeners are the most efficient as far as strength under water pressure is concerned.

2. The thickness or weight per square foot of the plating may be determined on the basis of its depth below or its height above the waterline, which corresponds to the deepest draft to which the ship may reasonably be assumed to be immersed in damaged condition. As a general rule it is proposed to make the weight of the strake immediately below this waterline not less than 7 pounds per square foot, and to add 1 pound for each additional 4 feet depth or 1/32 inch for each additional 5 feet depth. For plating above this waterline the weight should be decreased at the same rate. The thicknesses determined by this rule should be considered as minimum thicknesses, and must in many cases be increased to provide for corrosion, for general or local structural strength, or for the forces to which the plating may be exposed by the stowage of cargo.

Below the normal load waterline both butts and seams should be double riveted.

3. The stiffeners should be single, *i. e.*, each individual stiffener should be placed on one side of the bulkhead only. On all stiffeners of any importance a face bar or a reversed bar should be fitted on the free flange so as to balance as nearly as possible the strip of the bulkhead plating, which may be assumed to work with the stiffener.

A more efficient solution could be obtained with bars where one flange is heavier than the other. This would obviate the necessity for face plates or reversed bars, but it is a question whether such bars could be rolled without too great extra cost.

With the thicknesses of plating recommended above, the spacing of the stiffeners should not exceed 4 feet. The stiffeners should all be placed on the same side of the bulkhead.

4. The stiffeners should be provided with efficient brackets both at top and bottom, constructed by splitting the main bar of the stiffeners. The face plate, if any, should be continued the whole length of the bracket, and should have a good end connection. The height and width of the lower bracket should be about three times the depth of the stiffener, but in no case should the height fall below one-tenth of the length of the stiffener. The sides of the upper bracket may be about 10 percent shorter than those of the lower bracket.

The brackets should be attached to a rigid part of the ship's structure, such as a floor plate, a longitudinal or a deck beam, or else reinforcements must be introduced.

5. The bounding angles in all important bulkheads should be double up to a height of about 5 feet below the load waterline.

The author has worked out tables, which are included in the paper, by means of which the thickness of bulkhead plating and the size of stiffener can be determined in accordance with the foregoing rules.

No. 8—Comparative Results in Steam and Coal Consumption with Turbines, Reciprocating Engines and a Combination of the Two on the Steam Yacht Vanadis.

BY CLINTON H. CRANE.

ABSTRACT.

The steam yacht *Vanadis*, of 1,300 tons trial displacement, was built on the Clyde at the yard of Messrs. A. & J. Inglis, from the designs of the writer, and delivered by them in the spring of 1908. The propelling machinery consisted of the usual arrangement of Parsons turbines, with a high-pressure center and two low-pressures driving the wing screws. The guaranteed speed of the vessel was 15½ knots maximum, with a cruising speed of 13 knots, which was to be obtained on a guaranteed consumption of 26 tons of coal per 24 hours. On trial before delivery this guaranteed speed was exceeded by about one knot, and a 12-hour coal test was run at 13 knots when 13½ tons were supposed to have been burned.

At the time the vessel was designed several turbine yachts had been constructed, no one of which had shown economy in coal consumption, so that very special stress was laid on this question of economy at cruising speed. As a consequence the turbines were designed primarily with this end in view. However, the owner reported that the vessel was consuming very much more coal than the guaranteed amount; therefore, at the writer's request an exhaustive series of tests was run in the autumn of 1908, after the turbines, propellers, condensing plant, etc., had been thoroughly overhauled to the approval of the New York representative of the Parsons Marine Turbine Company.

The best test showed a consumption of 33 tons or 27 percent, more than the guarantee. In view of this unfortunate condition is was possible to do one of three things:

1. Lengthen the vessel to increase bunker capacity.

2. Remove turbines altogether and replace by twin reciprocating engines.

3. Remove the center high-pressure turbine and replace by a reciprocating engine, exhausting into the two low-pressure.

No. 3 was decided on. The contract for this alteration was let to the Staten Island Shipbuilding Company, and completed in January, 1910. In May following the vessel was run without propellers on the turbine shafts, being driven by the center propeller only, over the Glen Cove course, and subsequently a four-hour water consumption test was run at the revolutions required for 13 knots. The vessel was then re-drydocked and the turbine propellers fitted to the wing shafts, and in July of the same year the complete standardization coal and water tests were run in the new condition.

The summary of the coal and water consumption results of the three types of machinery is included in the paper. In estimating the amount of water used by the auxiliaries I have used a series of tests made at anchor of these auxiliaries. Apparently in the 13-knot condition with the combination, the propelling machinery is using about 14½ pounds per indicated

horsepower, the reciprocating engine alone about 17 pounds, and the turbines about 20½ pounds.

No. 9—The Gyroscope for Marine Purposes.

BY ELMER A. SPERRY.

ABSTRACT.

The uses of the gyroscope at sea fall properly under four general divisions: First, in affording means for resisting and preventing rolling of vessels or even rolling and controlling their motions at will; second, its use as a marine compass; third, for holding automobile torpedoes to their course; fourth, for artificial horizons in connection with observations at sea. There are two other uses which may be noted, that of recording the motions of ships, and also the use of a small gyroscope in controlling the oscillation of large, active gyroscopes for purposes of preventing rolling motions of the ship in their inception, and thus holding the ship against rolling. The first three only are treated briefly in this paper.

The most extensive use of the gyroscope to-day is probably the automatic steering gear in Whitehead torpedoes. This gear is simply used for the purpose of lateral guiding of the torpedo and holding same to a straight course. It offers positive resistance to any effort to turn it from its course, and this resistance is used to operate valves and, through a secondary motor, the rudders. This use originated with Obrey, an Austrian naval officer.

Our own Leavitt, engineer of the E. W. Bliss Company, of New York, and inventor of the Bliss-Leavitt torpedo, has greatly increased the efficiency of the "gyro" gear of torpedoes, and he has increased its accuracy by unloading the base ring; instead of requiring the base ring to do the work of moving a valve he cuts the duty required down to about one-hundredth of that required in the Obrey gear, and makes it give a simple directive factor to an extremely small pivoted pawl at the instant the pawl is otherwise perfectly idle.

Dr. Schlick has done much in connection with the gyroscope. He has gone further in the installation of large gyroscopes for steadying ships than any other. His gyroscope is of the passive type.

The question is often asked: Why is the gyroscope better than a moving weight in a ship for roll quenching? Barring the matter of list produced by the changes of center of gravity of the ship by the moving weight, the reason is perfectly apparent when you recall the magnitude of the stresses obtainable from a small machine. Every pound in the rotating mass of the gyroscope can easily be made to do the work of from 150 to 200 pounds, and directed in any desired line or plane, whereas, when we use water or any other form of moving weight, each pound represents a pound only, and can do the work of only a pound, and only in a vertical direction.

With the active type of gyroscope we find that a small part of 1 percent of the displacement of the ship will perform a very substantial service, down to the point of practically fully extinguishing the rolling. By the use of this device there is entire absence of any shift of the center of gravity of the vessel, and its stability remains unchanged. The sizes, weights, speeds and location of a gyroscope for this purpose are among the points which have been canvassed in tests carried on at the Washington navy yard during the past winter by Capt. D. W. Taylor.

The practical effect in operation of the active type of gyroscope is to secure a large reduction of weight over and above that possible with the passive type. With the smaller angles of roll, the gyroscope would have to be large enough so that its small angles of response would develop the required energy for extinguishing or still further reducing the roll, complete extinguishment being impossible; whereas with the active type the full 180 degrees oscillation of the gyroscope is always available, where required, for the extinguishment of large or even the smallest angles of roll as necessary. Thus an extremely small machine, taking advantage of the larger angles, between twenty and thirty times as large, is sufficient to accomplish this purpose.

When the motive power of vessels changed from an upsetting force to one almost exclusively of forward thrust, the design of ships underwent quite radical changes in connection with lines affecting the stability, decreasing this factor and favoring decreased resistance, aiding the attainment of higher speeds. Now that stability may be imparted to a structure of naturally small righting movement, and, as is well known, even to structures of unstable equilibrium, it is possible that we are on the eve of even more radical changes in design. Ships may now be designed that are practically free from those ballistic qualities which favor rolling structures to which unequal sea pressures easily impart motion need no longer be employed, as a comparatively small gyroscope which can easily be present in duplicate may very readily hold them practically free from rolling motions in such a way that ordinary seas will have little or no effect upon them, while an exceptional wave will have only a temporary effect. I heartily commend this subject to those who are interested in providing safety and comfort to passengers at sea, and as also preventing deterioration of certain classes of freight; for instance, live stock is known to suffer heavy depreciation in stormy weather. This is entirely outside naval uses especially as related to gunnery, trimming ships to secure level gun platform, suppression of recoil from broadside firing, and other uses.

In the cases where the gyroscope is employed as a battle compass, the apparatus is placed below decks, and small instruments about the size of an ordinary compass are distributed in different positions on the ship, giving the exact indications of the gyroscopic compass itself. My work has extended to the point where action of such instruments can be controlled from the gyroscopic compass and distributed as desired, the indications being accurate to a very small fraction of a single degree. Many observations have been made indicating that they are accurate to thirty-six hundredths of an entire circle. It will be understood that this type of compass is not affected in the slightest degree by the steel of the ship, or cargo, nor any magnetic disturbances in either; neither should shifting cargo, turning turrets nor gunfire disturb its accuracy or reliability, nor is it affected in the slightest by those disturbances technically known as deviation or variation.

No. 10—Some Suggestions for Reducing the Loss of Fire on Vessels.

BY SAMUEL D. MC COMB.

ABSTRACT.

The author of this paper calls attention to the appalling extent of the fire damage to shipping annually, and states that with a little precaution most of this loss could have been avoided. While the ideal construction would be to have a vessel constructed entirely of non-combustible material and carry only non-combustible cargo, nevertheless this is a condition which, of course, is impossible, but which can be closely approximated as far as the vessel itself is concerned. From the standpoint of fire hazard, vessels can be divided into three general classes, namely: Steam, gasoline and those with no power. Each of these three classes is taken up separately in the paper, and the principal causes of fires and the methods of extinguishing them are given in each case. The author has evidently drawn upon a fund of practical knowledge and his suggestions are numerous and valuable. It is impossible within the space of a brief abstract to enumerate the many details mentioned, but the paper will be published in more complete form in a future issue.

No. 11—Two Marine Installations of Producer Gas.

BY CHARLES B. PAGE.

ABSTRACT.

This paper describes two small boats operated by producer gas—the *Mary A. Sharp*, 66 feet long by 14 feet 6 inches beam with 5 feet 3 inches depth of hold and a 75 brake-horsepower producer and engine outfit, and the *Superior*, 65 feet long by 12 feet 9 inches beam, 4 feet depth of hold, equipped with a 50 brake-horsepower producer and engine.

The same general description will cover the interesting points of the power equipment of both boats. The producers used in both installations are the same type and make as fitted in the *Marenging* and *Carnegie*. The producer as shown in the photograph is a cylindrical steel shell lined with asbestos and fire-brick to such a thickness that, when running at full load, the heat radiation is not important. While the shell is rather warm to the touch, it cannot be regarded as hot. With proper ventilation this heat in summer is not objectionable, while it is most agreeable in other seasons of the year. The whole principle being one of suction or vacuum, there is no escape of gas into the boat. The writer has been aboard the *Mary A. Sharp* after she had been closed up for a week, excepting about half an hour every other day, when a little additional draft was given to the producer to keep the fire alive, and found no odor of gas in the engine room. At a suitable distance above the bottom to form an ashpit is located the grate and on a line with this are two fire-doors for slicing the fire and raking off the ashes. An ashpit door is fitted for the removal of ashes and clinkers. The coal is fed into the producer through a hopper on top and just below, reaching into the center, is the gas take-off pipe. The side walls of fire-brick are substantially vertical and we have then a fire-brick lined cylinder filled with anthracite pea coal in various stages of combustion. While operating, the hottest fire zone is from six to eighteen inches above the grate. Above this is a red hot and black hot layer of coal extending up to the take-off pipe. The top of the producer is effectively insulated by a considerable layer of coal around and above the take-off pipe. Thus it will appear that the producer itself is extremely simple.

Contrary to general land practice there is no water vaporizer whose function is to generate steam vapor which, mixed with the air and passed through the fire, serves the double purpose of enriching the gas (the steam forming water gas) and softening the clinker. A number of attempts have been made to incorporate this device with marine producers but without success, owing to the deposit of salt and the effect on the vaporizer of the rolling and pitching of the vessel. It is in fact a mooted question whether the presence of considerable water gas is not a detriment rather than an assistance to a smooth-running engine. This being the case, it is only necessary to find a substitute for steam for the softening of the clinker. Exhaust gas introduced under the grate has this effect. The exhaust line from the engine is accordingly tapped and a portion of the exhaust by-tapped to the producer. To keep the ashes and the bottom of the producer cool a small quantity of water is run into the ashpit, say fifty drops per minute on a 75-horsepower producer. Such steam as is formed from this small amount of water, of course, is turned into water gas and assists slightly in keeping down the clinkers.

With proper care the grate should last two years or more as the best operating conditions require a layer of ashes between the grate and the hottest fire zone. The fire-brick lining is good for three to five years according to usage and the skill of the operator. Relining is comparatively inexpensive.

The gas is taken off near the top of the producer through a two-way water-cooled valve, one outlet to the scrubber and the other to the purge stack. The latter carries off the gases from the producer when the engine is not drawing same through the scrubber. The purge pipe should be of sufficient height to induce enough natural draft to keep the fire alive when standing by for long periods—weeks if desired. The purge pipe is most conveniently run into a dummy stack which may also contain the exhaust mufflers. The scrubber, whose function is to cool and clean the gas, is shown in the photograph of the *Mary A. Sharp* located on the top of the engine-room house and after the stack. It is of the static type, is cylindrical in shape, and fitted with baffles, each section being provided with three water sprays. The material is copper and monel metal, to withstand the effect of salt water from the sprays and sulphuric acid from the gas.

Perhaps the most interesting feature of these two installations is the engine. It is two-cycle in principle, in that an explosion is effected in each cylinder each revolution, scavenging in action and substantially equivalent to the four cycles in efficiency. The commercial use of producer gas on shipboard involves the vital questions of weight, space, first cost, and simplicity. The two-cycle principle naturally appeals to the imagination of the marine engineer as fulfilling these requirements more easily than the four-cycle provided it can be made economical and reliable. In land practice we know of the Koerting two-cycle engines which are economical on full loads. Now a marine engine is operated at full power continuously. Hence it is evidently possible to fulfil the specifications for economy. Reliability is a matter of careful design, good material and workmanship, and high-grade ignition devices. If the use of a four-cycle engine is made difficult by reason of its weight, space required and first cost, the two-cycle engine should make marine producer gas power installations commercial.

The engines, as stated, are two-cycle. The explosive charge after expansion is completely blown out by a charge of air before the gas is admitted to the cylinder. The admission of the latter is so timed that none of the gas is lost through the exhausts ports. This gives a clean charge of great power and efficiency, and without any possibility of back-firing. Producer gas is particularly susceptible to back-firing, due to its slow burning, and in eliminating all back-firing in the type of engine described a decided forward step has been made. The saving in heat losses and in friction due to an explosion every revolution in each cylinder compensates in large part for the loss in the air and gas compressors. The working cylinders are of the ordinary construction, but with exhaust ports extending around the entire circumference of the cylinder. The exhaust gases pass with the utmost freedom from the cylinders to a large water-jacketed exhaust manifold. Differential pistons and cylinders are used as gas pumps. The downward stroke of the piston induces direct suction on the producer compressing same into a receiver on the upward stroke. This receiver communicates with the cylinder heads and the air and gas valves controlling their admission. Air only is drawn into and compressed in the base and of a volume of about 50 percent in excess of both the working piston displacement and the clearance in the combustion chamber. Both air and gas are admitted to the cylinder through mechanically operated valves and are so timed that such a proportion of the air as is intended for scavenging is firstly admitted, blowing out the burnt gasses. The gas valve is then opened, admitting gas direct to the cylinder and mixing with the balance of the air from the base.

The trials of the *Mary Sharp* were quite exhaustive and some interesting data was secured. On a non-stop run of eighteen hours' duration the engine averaged 60.8 indicated horsepower at 234.5 revolutions per minute; the coal burned per indicated horsepower per hour was 1.13 pounds; the weight of the engine and producer per brake-horsepower at the commercial rating of 75 brake-horsepower is 205 pounds.

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The Armaments of Battleships.

The various elements of battlehip design are so closely related that any discussion of a single element must necessarily be modified by a consideration of all the other elements. In considering the armament of a battleship it must be borne in mind that every fraction of the displacement of the ship which is devoted to armament must be at the expense of some other quality of the vessel, either of the armor protection, the speed or the steaming radius. Furthermore, when the most desirable relation is established between those elements, we find that, when it comes to the placing of the armament on the vessel, obstacles are met in the internal arrangement where as much attention must be given to the placing of the machinery as to the placing of the magazines, handling rooms, etc. Such considerations as these make it impossible to consider the question of armament irrespective of the other qualities of the ship.

The modern tendencies in the armament of battleships are fully outlined by Sir William White in a paper of exceptional value read at the annual meeting of the Society of Naval Architects and Marine Engineers. The author's arguments are mainly a protest against the present tendency to increase the size of armaments on battleships. His position regarding the matter is summed up in the statement that in no case is it desirable to carry more than the eight heavy guns in a single ship; that these guns are best arranged in four positions, as in the *Michigan* class, and that they should be supplemented by a powerful and well-protected secondary armament. In addition to this, the author expresses the belief that the present tendency toward the use of larger caliber guns than the 12-inch is but temporary, and that in the course of time the fashion in warship design will again revert to the use of the 12-inch gun.

There is no doubt but what the armament suggested by Sir William White is one in which the maximum efficiency can be gained for each element of the armament. Limiting the number of big guns to eight permits the guns to be mounted in what is generally accepted to be the most efficient manner possible—namely, that which was first used on the United States battleships *Michigan* and *South Carolina*—while this disposition of the main battery also leaves room for the most effective emplacement of the secondary battery. Apparently there is strong belief that at present such an armament, involving the use of 12-inch and 6-inch guns, is sufficiently heavy for all practical purposes. Twelve-inch shells will pierce any armor which is now used on a battleship, so that the only effect gained by increasing the caliber of the guns is to increase the bursting power of the shell; and just how useful this would be, in view of the fact that, by using lighter guns, probably a more rapid rate of fire would be maintained, is debatable. Although it is generally conceded that future naval battles will be fought at long range, it is, nevertheless, true that atmospheric conditions will at times very materially reduce the range, and, consequently, make the lighter secondary armament doubly effective. It is unfortunate that, after such a frank and complete expression of opinion regarding the subject has been made by the leading authority in Great Britain, naval officers in America are not permitted, on account of official regulations, to be equally frank in their discussion of the paper, since the tendency toward larger ships and heavier armaments is nowhere more apparent than in the United States navy.

In the discussion of the paper, however, one subject was touched upon which, it seems to us, should not be overlooked in the consideration of armaments, and that is the importance of under-water attack, either by torpedoes, submarines or mines. Submarine warfare is bound to play an important part in any future engagements, and the possibilities of striking an effective blow at the enemy in this manner are daily becoming greater as further progress is made in the development of the range and accuracy of torpedoes and in the increase in size and efficiency of submarines. Although litle consideration seems to have been given in existing war vessels to protection against such at-

tack other than the use of a deep and minutely subdivided double bottom, yet it seems almost imperative that future vessels should have some more adequate form of protection against such attack.

Protection from Fire on Board Ship.

The risk of fire at sea can never be eliminated so long as ships are built of inflammable materials, and since at present it is impossible to build ships which are absolutely fireproof, this risk must be given careful consideration. Even in steel cargo vessels, where the construction is as nearly fireproof as possible, there is still the risk of fire in the cargo. Needless to say, almost every fire on board ship occurs through carelessness. Spontaneous combustion sometimes occurs with some forms of cargo or with coal, but it is not so difficult to fight a fire which is confined to a coal bunker or to a special cargo hold, where the progress of the fire is apt to be slow, as it is to overcome one which sweeps through the passenger accommodations on a vessel or through a deck load of miscellaneous cargo.

The number of ways in which fires originate on board ship are clearly pointed out in one of the papers read at the annual meeting of the Society of Naval Architects, and some valuable suggestions are given as to the best methods of preventing them. One point was brought out in the discussion of the paper by a representative of the New York City fire department which deserves consideration, and that is that, as a rule, steam is not effective for putting out cargo fires on board ship; its use frequently results in greater damage than the fire itself, due to the excessive heat maintained in the hold for a long period of time. It was suggested that a better means of fighting such a fire is to have a piping system installed whereby water can be poured into the holds instead of steam. This, as was pointed out by one of the members, theoretically should be more effective than the use of steam, since the introduction of water, while it does not smother the combustion, as does steam, by driving out the air, nevertheless takes away the heat at a rapid rate, and, at the same time, gradually saturates the cargo until the fire is put out.

A great deal of thought and attention is given to the question of fire protection in the design of every modern steamship, and the comparative freedom from disastrous fires on passenger vessels and the small loss of life from this cause are sufficient testimony to the good results which are obtained. It must not be forgotten, however, that on board ship there is not only a large crew continually on watch, so that a fire has little chance to gain headway before being discovered, but also the passengers themselves occupy such a large share of the boat that few parts of the vessel, except the cargo holds, are not constantly in view of someone. This in itself is one of the greatest means of protection against the spreading of fire on board ship. The more or less frequent occurrence of fires on board vessels while laid up in port and the comparative infrequency of disastrous fires while the ships are in commission bear out this statement, and should give the traveling public a sense of security from danger from this source which they might not have from a realization of the fact that vessels are built largely of inflammable materials.

The Gyroscope.

Of all the purposes for which a gyroscope can be used on board ship, the one which has engaged most attention is that for the prevention of the rolling of ships. Various other devices have been suggested and even developed with a great deal of care and thought to accomplish this same purpose, but apparently the gyroscope in its present stage of development offers more advantages for this work than any other device which has yet been proposed. The importance of reducing the rolling of ships may have been overlooked by many because the problem has seemed so difficult to solve, yet when it is considered that, in reducing or preventing the rolling of ships, we immediately add greatly to the safety and comfort of passengers at sea, as well as prevent the deterioration of certain classes of freight, such as live stock, besides providing better conditions for gunnery on war vessels, it is at once evident that the problem is worthy of a great deal of attention. According to the views expressed at the annual meeting of the Society of Naval Architects, where the subject was fully discussed, a modern gyro-steadying plant of the active type is now well within the practical limits of space, weight and cost suitable for application to steamships. It was stated that the weight of such a device for each degree of roll-quenching power on a modern battleship would be about one-tenth that of the submerged armor displaced and cost much less. With this type of gyroscope it has been found that a small part of 1 percent of the displacement of the ship will perform a very substantial service down to the point of practically fully extinguishing the rolling. The immense power of the gyroscope can readily be seen when it is understood that every pound in the rotating mass of the gyroscope can easily be made to do the work of from 150 to 200 pounds, and, furthermore, this force can be directed in any desired line or plane. Where this result can be obtained on such a slight increase in displacement and where the apparatus takes up only a moderate amount of space and the investment required is not excessive, it is evident that the gyroscope, as a means for preventing the rolling of ships, is bound to play an important part in future in the design of certain classes of vessels. The adoption of bilge keels for decreasing rolling has now become almost universal, and yet their effect is slight as compared to the effect of a gyroscope, particularly at small angles of heel.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports the following percentages of completion of vessels for the United States navy:

BATTLESHIPS.

	Tons.	Knots.		Oct. 1.	Nov. 1.
Florida	20,000	20¾	Navy Yard, New York	77.4	80.6
Utah	20,000	20¾	New York Shipbuilding Co.	88.0	89.9
Arkansas	26,000	20½	New York Shipbuilding Co.	47.8	50.1
Wyoming	26,000	20½	Wm. Cramp & Sons	38.9	43.3

TORPEDO-BOAT DESTROYERS.

	Tons.	Knots.		Oct. 1.	Nov. 1.
Drayton	742	29½	Bath Iron Works	94.4	100.0
Terry	742	29½	Newp't News Shipbuilding Co.	99.0	100.0
Perkins	742	29½	Fore River Shipbuilding Co.	97.4	98.1
Sterrett	742	29½	Fore River Shipbuilding Co.	90.8	92.5
McCall	742	29½	New York Shipbuilding Co.	95.9	96.0
Burrows	742	29½	New York Shipbuilding Co.	94.9	95.1
Warrington	742	29½	Wm. Cramp & Sons	84.7	89.1
Mayrant	742	29½	Wm. Cramp & Sons	83.7	86.7
Monaghan	742	29½	Newp't News Shipbuilding Co.	35.6	46.1
Trippe	742	29½	Bath Iron Works	68.3	76.0
Walke	742	29½	Fore River Shipbuilding Co.	57.5	66.5
Ammen	742	29½	New York Shipbuilding Co.	72.4	76.5
Patterson	742	29½	Wm. Cramp & Sons	47.8	51.7

SUBMARINE TORPEDO BOATS.

	Tons.	Knots.		Oct. 1.	Nov. 1.
Seal	...	..	Newp't News Shipbuilding Co.	55.9	71.4
Carp	...	..	Union Iron Works	63.0	70.0
Barracuda	...	..	Union Iron Works	64.8	71.1
Pickerel	...	..	The Moran Co.	61.1	64.3
Skate	...	..	The Moran Co.	61.1	64.3
Skipjack	...	..	Fore River Shipbuilding Co.	56.3	57.5
Sturgeon	...	..	Fore River Shipbuilding Co.	55.4	57.8
Tuna	...	..	Newp't News Shipbuilding Co.	32.4	33.9
Thrasher	...	..	Wm. Cramp & Sons	15.7	20.2

ENGINEERING SPECIALTIES.

Austin Rotary Engine.

A triple-expansion reversible rotary engine is being placed on the market by the Austin Rotary Engine Company, Second avenue and Eighth street, Brooklyn, N. Y. Each expansion stage of the engine is constructed with a middle section, and a half section on each side of it, the size of the middle section being just twice that of the outer sections, and, as the middle and outer sections are diametrically opposite, the forces are balanced. Steam is controlled by a piston valve on top of the engine, and a simple movement of this valve throws the engine from ahead to reverse, or in the mid position steam is shut off entirely. In a compound or triple-expansion engine of this type the valves on the several stages of the engine may be controlled from a single lever. In a triple-expansion engine the intermediate stage is four times as large as the high-pressure, and the low-pressure is six times as large as the intermediate; therefore, giving a theoretical expansion to twenty-four volumes and an actual expansion of about twenty. The best results are obtained through the use of a condenser and a 26-inch vacuum.

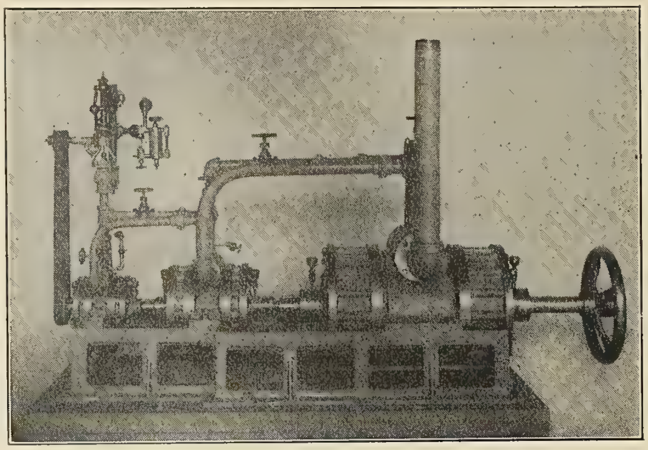


FIG. 1.

The construction of the pistons is shown in the line cut. There are four pistons in each section which are connected through the hub and shaft by means of rods. These bars are inserted in sockets in the inner sides of the opposing pistons and on each end of each piston is an oscillating face plate, connected to the piston by a ball joint. A tight joint is maintained between the cylinder walls and the face plate by the admission of steam through suitable passages behind the piston forcing it out against the cylinder wall on the working stroke. In Fig. 2 the spaces *O* and *P* are filled with steam.

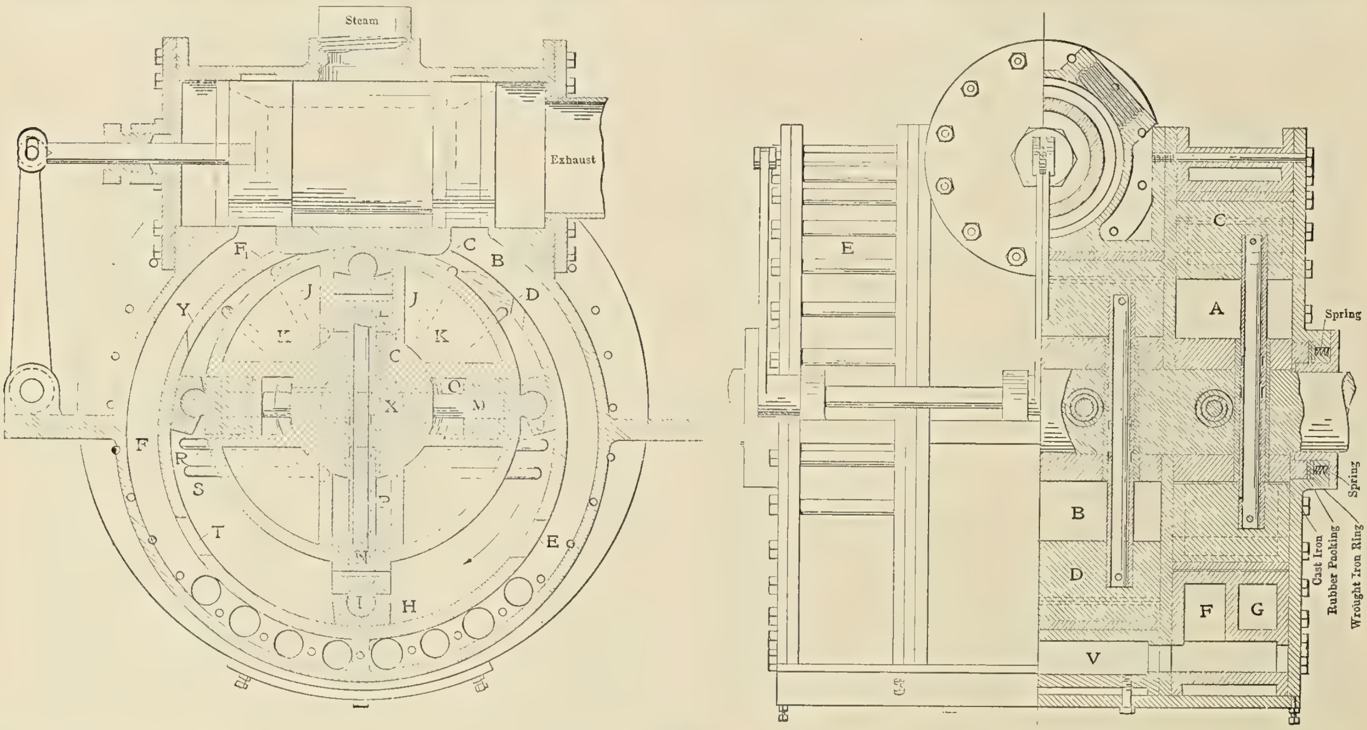


FIG. 2.

On the latter part of the stroke this steam is exhausted. By this method it is claimed that the pistons can be readjusted as wear occurs.

When the engine is turning in the direction shown in Fig. 2, steam enters the space *B*, and, passing into the grooves *J* and *K*, forces the piston *M* out from the center of the hub *X*. At the same time steam is entering the port *D*, but exerts practically no power on the piston *M*, as the pressure on both sides is about equal, but the steam entering the port *E* is practically opposed by the entire area of the piston *M*, and the pressure causes this piston to move in the direction of the arrow. When the piston *L* reaches the port *C*, *M* passes the port *E*, the steam entering through the port *D* acts upon the piston *M*, and when it has passed the port *E* the piston *L* reaches the port *D*, and the rotation of the hub *X* is produced by the pressure of the steam on the piston *M*. During this period the piston *M* is moved by the exhaust side of the cylinder, and when it passes the exhaust port *F* the steam escapes to the passages *F* and to the exhaust port. If the engine is reversed, the action of the steam is the same only in a reverse direction.

The shaft is packed by a special form of packing, which consists of a spiral spring against which a wrought iron ring rests and next a soft rubber packing, on top of which is placed a cast iron ring, the whole being placed in annular grooves which are provided in each hub concentric to the shaft. The soft packing expands against the side of the annular groove, packing the groove and so preventing the leakage of steam. It is claimed that leakage of steam by the piston is not excessive and that the steam consumption of the engine is about the same as that of a well-designed reciprocating engine of similar power.

A 45-horsepower engine operating at 400 revolutions per minute has been in successful operation in a 50-foot launch for several months, where its freedom from vibration, its durability and excellent maneuvering powers have been repeatedly demonstrated.

A New Type of Gas Engine.

A gas engine which combines the two and four-cycle principles in a single motor is being placed on the market by the New York Engine Company, 165 Broadway, New York. This engine is the invention of John L. Bogert, consulting engineer of the above company, who has had a small engine of this type in operation for some time at the Fulton Foundry &

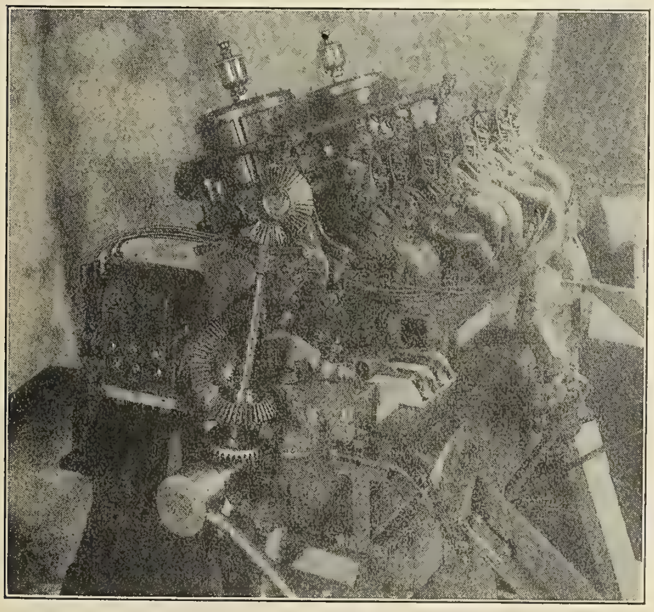


FIG. 1.—VIEW OF FOUR-CYCLE CYLINDERS.

Machine Company, Brooklyn, N. Y., where the features of the engine were demonstrated.

The combination of the two and four-cycle cylinders and the manner in which they operate can be seen from the sectional drawing and the photographs. In the experimental engine there were six 4-cycle cylinders, 4 inches by 3 inches,

FIG. 2.—VIEW OF TWO-CYCLE CYLINDERS.

and two 2-cycle cylinders, 5 inches by 3 inches. The fuel used was gasoline (petrol) supplied in the ordinary manner to the 4-cycle cylinders. The customary intake and exhaust ports are arranged in these cylinders and controlled by a cam shaft driven from the main shaft by bevel gears. The combustion space of the 4-cycle cylinders is connected to the space underneath the pistons of the 2-cycle cylinders by passages which are closed by poppet valves. These valves are kept closed by the pressure of the air, which is compressed in the 2-cycle cylinders and remain closed until the charge is ignited in the

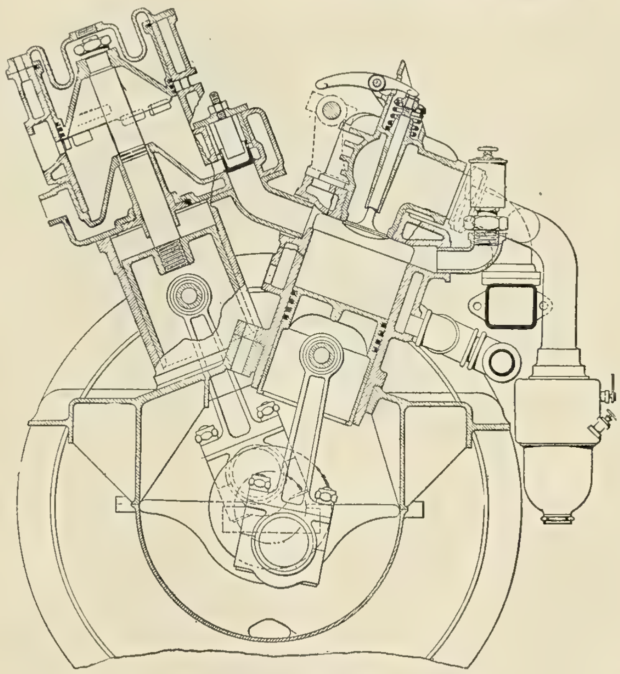


FIG. 3.—SECTIONAL VIEW OF ENGINE.

4-cycle cylinders, when the pressure immediately rises and overbalances the pressure of the compressed air on the 2-cycle side, raising the valves and admitting a portion of the burning gases to the space below the 2-cycle pistons. This part of the charge, mingling with the compressed air, carries out the working stroke in the 2-cycle cylinder and, on account of the excess air, it is claimed that the combustion is complete.

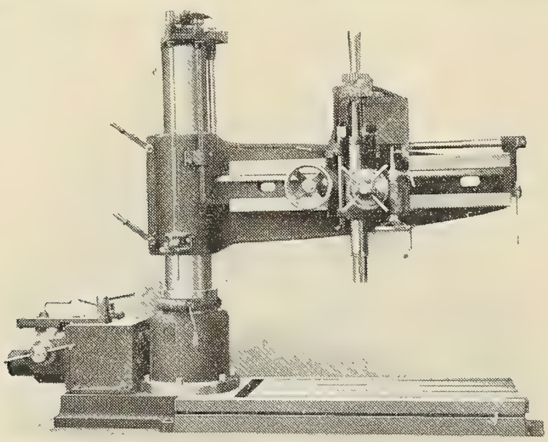
Each 2-cycle cylinder is connected to two of the 4-cycle cylinders, and the space above the 2-cycle pistons is used for compressing air on the upward stroke of the piston. This compressed air is transferred from the upper to the lower side of the piston when the piston reaches the top of its stroke by means of ports in the cylinder wall. When the 2-cycle piston is at the end of its downward stroke it uncovers a port in the wall and admits a fresh charge of air above the piston.

The temperature of the exhaust gases from this engine is very much lower than the temperature of the exhaust from an ordinary 4-cycle gas engine, and this, together with the greater expansion and complete combustion of the fuel, it is claimed, results in greater fuel economy than can be obtained with engines operating on the ordinary cycle. The action of the engine is somewhat like that of a Diesel engine, except that the high pressures and high temperatures and the consequent difficulties attending the upkeep of the engine under these conditions are eliminated. The engine can be operated on either gasoline (petrol), heavy oils or producer gas, and it is particularly adapted for marine work.

High-Speed Radial Drill.

George Swift & Sons, Halifax, have on the market a type of high-speed radial drilling, tapping and studding machine with gear box drive and geared feeds which has been designed to meet the demand for a rigid machine to stand up under the severest duty, and to deal with high-speed drills at their greatest speeds and feeds and be easy in manipulation in all movements.

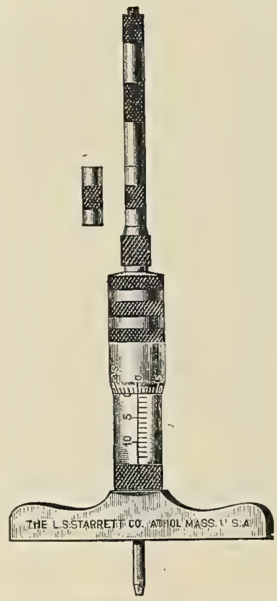
The arm is raised and lowered by power through gearing on top of the column. The saddle is moved along the arm by means of a rack and pinion. The spindle is fitted with ball



thrust washers at both ends, and provided with hand and power feeds, a quick advance and return and a reverse motion for tapping. The spindle is balanced by a spring instead of a counterweight. The reversing motion is carried at the back of the saddle by a double clutch, controlled by a lever in front of the saddle, giving complete control for the spindle without interfering with any other part of the machine. There are sixteen changes of speed which are controlled by three levers. No friction clutches are used, and all of the speeds are positive. This machine can be driven direct from the main line shaft, dispensing with countershafting, and is furnished in sizes from 4 feet 6 inches, which has five changes of feed, to 6 feet and 7 feet 6-inch machines, which have nine changes of feed.

Starrett Micrometer Depth Gage.

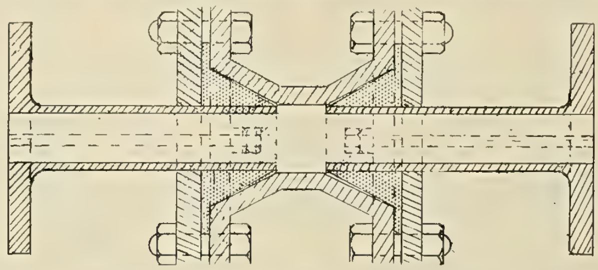
This gage is designed for measuring the depth of grooves, holes or irregular parts. It has a ½-inch movement of the screw reading in thousandths, and with two ½-inch and one 1-inch standard collars to slip off or on the spindle 2½-inch readings in thousandths can be obtained. The split nut is covered and protected by a patent graduated sleeve, which not only protects the nut from dirt but provides a quick and



accurate way of taking up wear and adjusting the micrometer to insure correct reading. The sleeve being held by a stiff friction may be rotated by a spanner, so that the zero lines will coincide for correct reading. The head is about 3/10 inch thick. This and the point of the measuring rod are hardened. This tool is manufactured by the L. S. Starrett Company, Athol, Mass.

The Goodby Expansion Joint.

The illustration shows a sectional view of an expansion joint manufactured by Goodby's Limited, 24 Great Tower street, London, E. C. This joint acts as a union and is suit-



able for all pressures of superheated and ordinary steam as well as for hot-water piping. There are no packed glands, and it is claimed to be very sensitive, due to the small area of rubbing surface. This also makes it adapted to light steel piping. The conical rings of the Goodby joint are claimed to give exceptional strength and durability.

Flexible Covering for Ferry Racks.

Ferry racks are peculiar structures which differ from all others. The converging walls of the rack are necessarily made of wooden piles, connected together by cords, to produce a structure strong and firm enough to resist the impact of the boats, and, at the same time, having a resilient character, so as to yield sufficiently to such impact. It has been shown on various ferry properties that the timber of this nature, when it has been protected by a covering from the rain, sun and

snow, has universally given an increase in life of double that unprotected and exposed to the weather; and to provide such protection a unique form of a flexible covering for ferry racks has been designed and patented by F. W. Bacon, Englewood, N. J.

This sectional covering is peculiarly arranged and supported, so that it will not interfere with the varying and irregular movement of the rack, nor will it be displaced, crushed or damaged due to the extreme flexible nature of its design. It consists of a series of frames, 12 feet in width, covered with a suitable water shedding material. The frames are supported by flexible hangers, fastened by means of an eye-bolt to a cord run on the beveled top of the front row of piles. The frames adjacent to their upper edges rest upon this cord to which they

are thus connected. A similar cord is run on the back of the lowest row of piles to be covered, upon which the lower end of the frames rest. There is thus produced a sectional protection curtain, so supported that it is free to move in full relation to the piles. The length of the cover varies according to the individual rack, number of rows of piles, etc. It is entirely applicable to any form or design where rigid construction is not practicable. The top of the rack is protected by a sectional covering held in position by a cleat against the facing planks. The entire covering can be removed or replaced on the rack in a very short time when found necessary during a period of repairs.

Ferry racks represent a large investment, with a high maintenance cost that is increasing annually in proportion to the increased cost of labor and materials, and experience with this flexible covering at the West 130th street rack of the Riverside and Fort Lee Ferry Company, New York, has shown that by its use the maintenance cost can be greatly minimized.

Obituary.

LOUIS C. TAYLOR, secretary of the Durable Wire Rope Company, Boston, Mass., died Thursday, October 27, 1910.

Correction.

In the article "Some Data on Paddle-Wheel Steamers" on page 445 of our November issue, mention is made of the steamers *Middlesex* and *Maryland* in a manner that is somewhat misleading, giving the impression that these boats are of the Mississippi River type since they are called "Southern River and Harbor Steamers." As a matter of fact, these vessels ply on the comparatively deep and often rough waters of the Chesapeake Bay and its numerous tributaries. The *Middlesex* is owned by the Maryland, Delaware & Virginia Railroad Company, and the *Maryland* by the Baltimore, Chesapeake & Atlantic Railway Company, two affiliated companies owning and operating about forty steamers.

TECHNICAL PUBLICATIONS.

Heat Engines. By John R. Allen and Joseph A. Bursley. Size, 6 by 9 inches. Pages, 288. Illustrations, 157. New York, 1910: McGraw-Hill Book Company. Price, $3 net.

As this book is intended as an elementary text-book, the subjects, which include steam and gas engines, steam turbines and their auxiliaries, are all treated in as simple and elementary a manner as possible. The higher mathematics are avoided almost entirely except in a single chapter on elementary thermodynamics. Compared with many text-books on heat engines, perhaps this one will seem unduly brief, but it should be remembered that it is intended to be used in connection with class work for the instruction of students in these subjects, and that all the matter included in the book is simply the basis of the work which is to be amplified in the class room. A great deal of material, however, has been condensed into a small space, and by the use of timely illustrations the text is made exceedingly clear and useful. In each division of the text, problems have been worked out in detail to show the application of the subject matter which is treated, and a large number of problems have been introduced for class-room work. The design of engines has not been considered, as it was felt that that subject did not properly come within the scope of this work.

Engineering Reminiscences. By Charles T. Porter. Size, 6 by 9 inches. Numerous illustrations. New York, 1908: John Wiley & Sons. Price, $3 net.

Owing to the recent death of the author of this book the attention of many engineers, particularly of the older men of the present generation, will be turned toward this record of Mr. Porter's engineering work. The book is essentially an autobiography, in so far as it concerns the professional side of the author's life. It is written in a particularly pleasing style, and touches on many important events in the engineering world during the last half century.

Mr. Porter was born in Auburn, N. Y., and graduated at Hamilton College, and was soon after admitted to the bar. He practiced law in Rochester, N. Y., and New York City for six or seven years, but soon had his attention turned to mechanics by some of his clients who were bringing forward various mechanical inventions. His first successful venture in the mechanical field was the design of a stone-dressing machine, which had been brought to his attention by a client. This machine was run at very high speed, and laid the foundation of Mr. Porter's ideas which subsequently were developed in the high-speed engine for which he is famed. Mr. Porter's next invention was a weighted governor, which proved a great success. This governor was used in a great many installations, but Mr. Porter had considerable difficulty in introducing it in the marine field. He designed a special marine type of governor which was first installed on the first North German Lloyd liner *New York*. Its successful operation on this vessel led to its general use on simple marine engines.

Soon after the development of the governor, Mr. Porter became acquainted with Mr. J. F. Allen, who had in mind a new type of valve gear operating a double-ported valve giving large opening and small lap. Mr. Porter was very much impressed with this design, and, together with Mr. Allen, worked out the design of a high-speed engine. In connection with this engine, Mr. C. B. Richards invented his well-known indicator, for which Mr. Porter purchased the patents. Space does not permit of going into the history of the development of the high-speed engine, nor, in fact, is it necessary, as it is well known to most engineers.

During the last few years of his life Mr. Porter was engaged in consulting engineering work, and in 1909 he was awarded the John Fritz medal by the American Society of Mechanical Engineers, of which he was an honorary member.

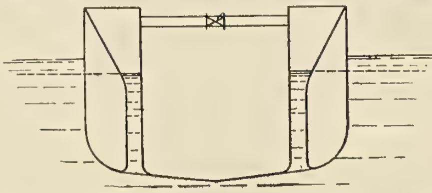
SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

968,927. MEANS FOR PREVENTING THE ROLLING OF SHIPS. HERMANN FRAHM, OF HAMBURG, GERMANY.

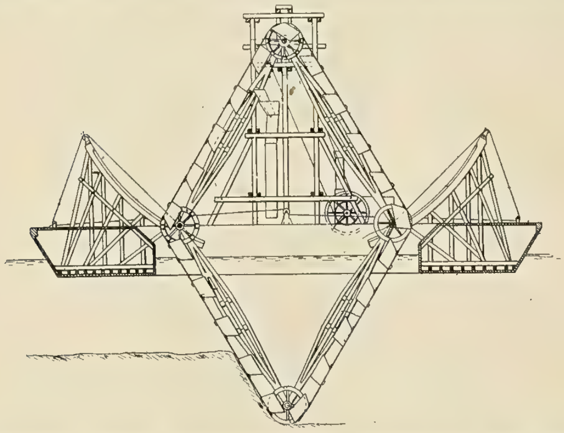
Claim 1.—Apparatus for damping the rolling motion of ships having within the ship, a vertical chamber at each side of the ship, said



chambers being widened upwardly and connections from the bottom end of each of said chambers to the sea water, said chambers and connections being so diminished that the periodic oscillations of water in and out of said vertical chambers are substantially equal to the natural period of oscillations of the ship. Four claims.

969,171. UNIVERSAL DREDGING MACHINE. THOMAS F. LONNEY, OF BROOKLYN, N. Y., ASSIGNOR TO GEORGE UPINGTON, OF BROOKLYN, N. Y.

Claim 2.—A float, a derrick carried thereby, a pair of trusses pivoted to said derrick, each being adapted to be moved with or independently of



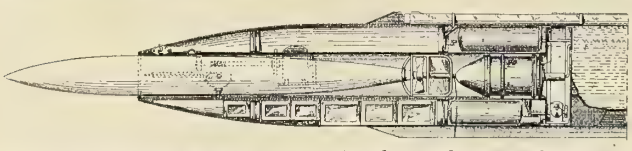
its companion, trusses hinged to the lower portions of said swinging trusses and converging to form a toe, and an endless chain of buckets mounted to travel around the aforesaid frame work, whereby upon swinging one or both of said swinging trusses the toe of said frame work may be raised or lowered to excavate at different depths. Thirty-five claims.

969,628. FASTENING FOR LIFE-BOAT COVERS. CHARLES F. HUDGINS, OF NORFOLK, VA., ASSIGNOR OF ONE-HALF TO FRANK M. PHILLIPS, OF WASHINGTON, D. C.

Claim.—The combination with a life boat and a removable canvas cover therefor, of a plurality of securing devices depending from the side of said cover, each securing device embodying a base plate having an eye at its upper end, a tongue pivoted at the lower end thereof, a loop pivoted to the plate intermediate said eye and tongue and adapted when swung down over the tongue to hold the tongue in locked position, and a lanyard connected with the loops, whereby the loops may be simultaneously raised and the tongue permitted to fall by gravity. One claim.

970,210. SUBMARINE TORPEDO BOAT. ALVARADO M. FULLER, OF TOPEKA, KANSAS.

Claim 1.—The combination with a buoyant tube or shell, of a torpedo

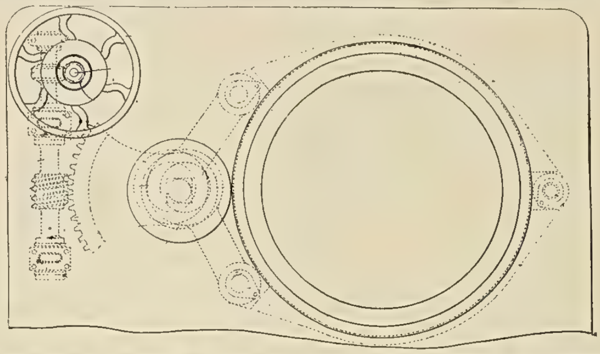


carried thereby and forming a bow therefor, and means thrown into action on the expulsion of the torpedo to form a temporary bow for the said tube or shell. Sixty-four claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 21 Southampton building, W. C., London.

6,349. BRAKE MECHANISM FOR CAPSTANS, WINDLASSES, ETC. CLARKE, CHAPMAN & CO., LTD., AND W. D. COOKSON, GATESHEAD-ON-TYNE.

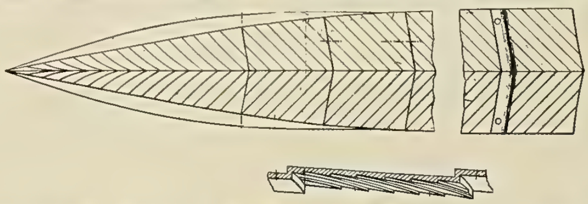
By this invention the straps of the eccentrics that move the ends of the brake band relatively to each other are connected to the ends of the band by links. The eccentric, on which the strap of one link is mounted, is displaced, in relation to the eccentric on which the strap of the other link is mounted so that both parts of the brake band are



simultaneously applied or released by a partial rotation. In another arangement the eccentric straps embrace a common eccentric. The lever carries a trunnion nut through which works a screw mounted in bearings and actuated by bevel gear from a hand wheel.

14,627. CONSTRUCTION OF BOATS AND SHIPS. W. H. FAUBER, NANTERRE, FRANCE.

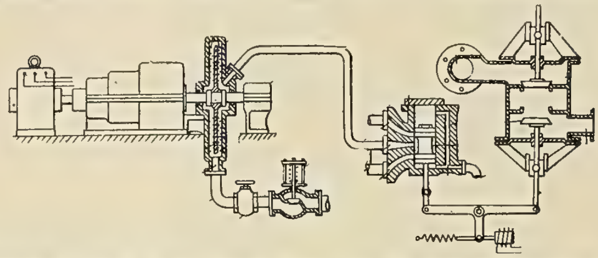
Relates to improvements in boats such as described in the inventors' specification No. 20,281—1908. According to the present invention, the auxiliary steps are arranged to run from the keel-line diagonally across



the hydroplane members; they commence at the side of the vessel and cross the bottom surface diagonally and rearwardly towards the keel. When these boats run at a high speed, only the rear portion of the hydroplane surfaces proper are in contact with the water, so that at each step between two hydroplane members an air-pocket is formed. Owing to the diagonal arrangement of the auxiliary steps, the air contained in this pocket passes along the diagonal channels and is spread in a thin film over the surface of the hydroplane member.

20,586. SYSTEMS OF PROPULSION. J. N. BAILEY, STRETFORD, LANCS.

Relates to means for braking the turbine rotor. In one form, an oscillating lever, by means of solenoid, steam is shut off by one valve and another valve is moved to admit water to brake-turbine disc, the

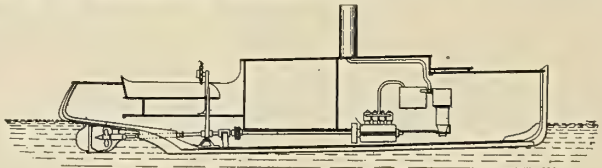


rotation of which is thus slowed down with the shaft of the main turbine, to which it is keyed. When not in use for braking, the disc rotates in vacuo and offers no resistance. Other forms of brake are described.

23,790 AND 28,976. STEERING VESSELS. M. G. HARRISON, NORTON-ON-TEES, DURHAM.

This invention relates to an indicator fixed to the stanchion for the ship's awning in the center of the fore part of the bridge deck rail, and comprises a vertical arm pivoted in a frame. This frame is secured to the stanchion and carries at its extremities adjustable pulleys geared by cords to pulleys at the lower end of the arm. These cords are carried suitably to a drum on the steering wheel spindle, so that one cord or the other is pulled by the rotation of the wheel to move the arm from its mid position towards starboard or port.

27,736. MOTOR BOATS. A. P. MACLAREN, F. L. MACLAREN AND H. B. MACLAREN, DUMBARTON.



The invention comprises a novel combination of a producer, internal combustion engine and reversing or folding propellers.

29,321. LOADING SHIPS BY CABLE-WAY CONVEYOR. H. O. ADAM, DRESDEN, GERMANY.

Relates chiefly to devices for preventing winding of the slings upon the transporting cable. The slings are placed on sleeves (open at bottom so that slings may pass under them) loaded and pushed off on to the cable. Each pulley has a guiding horn, which compels the sling to pass on the free side of the pulley so that it cannot twine about the cable; or the pulley may be arranged angularly. The loads are discharged by destroying the slings.

TRADE PUBLICATIONS.

AMERICA

Metropolitan injectors are the subject of an illustrated catalogue published by the Hayden & Derby Manufacturing Company, 85 Liberty street, New York. This is a valuable booklet, and should be in the hands of every user of injectors

"Fire Protection" is the title of a 224-page catalogue issued by S. F. Hayward & Company, 39 Park Place, New York City. As is truly stated in the catalogue, this company sells "anything and everything for fire protection." Among the supplies illustrated are chemical fire extinguishers of many types, fire engines, hose and hose carts, Monitor and other nozzles, lanterns, bells and smoke and ammonia helmets. The Glazier Universal Nozzle, which will be sent on trial, is especially designed for marine use. This is a flexible nozzle for stationary pipe or hose connection. It can be turned in any direction, and will remain in position without attendance.

"New Starrett Tools" is the title of a supplement which has just been issued to catalogue No. 18-L, published by the L. S. Starrett Company, Athol, Mass. A number of these tools have been the subject of individual leaflets which have been issued within the past few months. The protractors and sets, however, on pages 2 to 7 are entirely new, and have not been hitherto illustrated. Among other tools described and illustrated in this catalogue are inside gages, wire and thickness gages, universal bevel protractors, tool makers' buttons with screws and washers for jib work, quick-adjusting micrometers, calipers, carpenters' scratch gages, folding steel rules, etc.

The flexible metallic tubing, made by the Schoen-Jackson Company, Media, Pa., is described in a catalogue published by this company. "The importance of a flexible metallic hose as a substitute for rubber has been a long-felt want in this country, for use where a flexible medium is required and where rubber hose quickly disintegrates or cannot be made to withstand certain required conditions. It is a well-known fact, and admitted even by manufacturers of rubber hose, that there are many uses for a flexible metallic hose to which rubber is not well adapted, owing to the component parts all being composed of vegetable matter, which naturally is affected by temperature, by oils and various chemicals which do not affect metal. While our flexible metallic hose is suited to all ordinary uses where rubber hose is applied, it is especially valuable for use where rubber hose quickly fails."

Valves of many types, oil pumps, sight-feed oilers, injectors, and many other marine steam auxiliaries are described in illustrated circulars published by the William Powell Company, Cincinnati, Ohio. For this company's "Cyclone" blow-off valve the claim is made that its construction is so simple that it enables the engineer to adjust the valve at any time with an ordinary monkey wrench, a great convenience when it needs repacking. The disc and seat bearing are constructed with such a large angle that it is impossible for any sediment or scale to lodge between them, either while blowing off or closing the disc, so that they are not worn out after a few months of use. Every valve is tested to 250 pounds hydraulic pressure. The William Powell Company's improved screw-feed grease cup is especially designed for marine engines, and where it is desired to force the grease some distance, as in air compressors, ice machines, etc. It is said to be particularly desirable for intermittent or positive feed.

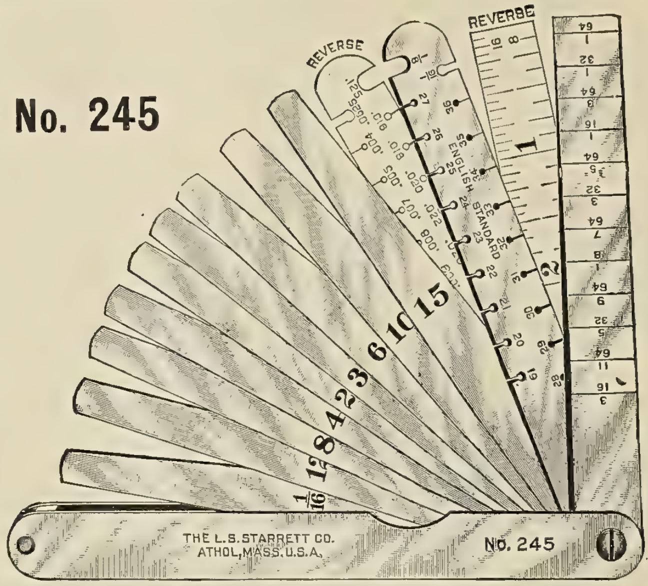
Consolidated pop safety valves are described in a handsome cloth-bound volume of 78 pages, published by the Consolidated Safety Valve Company, 85 Liberty street, New York City. "The Consolidated Safety Valve Company has within the last two years inaugurated two exceedingly important movements in the safety-valve practice of this country—movements which are causing universal modifications of design, and, for the first time in the history of engineering, are putting the methods of safety-valve rating and specifications upon a sound basis. This has, of course, required exhaustive testing and research, in conducting which this company has spared no expense, deliberately adopting the policy of giving the results freely to the engineering public. This policy has obtained for the company in this work the co-operation of railroads, of stationary and marine interest, and of eminent engineers, adding much to the broad application and value of the results obtained. The movements referred to are: First, for the rating and specifying of safety valves according to their actual relieving capacities; and, second, for increasing their efficiency by modifications in design, which make possible the obtaining of larger capacities and a cleaner, more positive action."

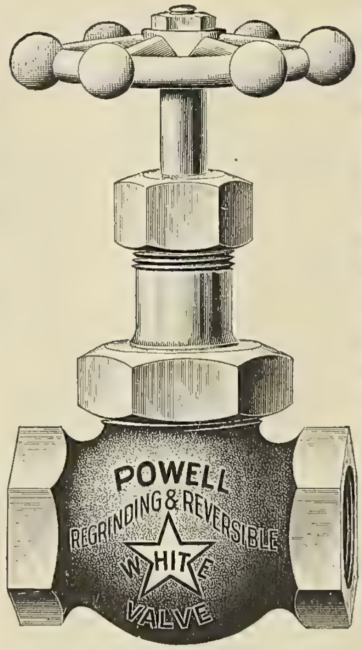
Drilling, boring and tapping machinery is the subject of an illustrated catalogue published by Baker Bros., Toledo, Ohio. The statement is made that the machines described in this catalogue have a much larger field of usefulness than has been recognized in the past, and that they are unexcelled as chucking machines for drilling, boring, reaming and counter boring. For general machine shop use they are stated to be especially valuable for rapid production of accurate duplicate work, such as general chucking work, boring small engine cylinders, boring and turning collars, sleeves, hubs, bosses, gears, pump valves, connecting rods, locomotive valve gears, and a large amount of similar work for which they are suited because of their power, durability, convenience and accuracy of alinement.

"On Land and Sea" is the title of a booklet published by the "Diamond" Power Specialty Company, 234 Fort street, West, Detroit, Mich. This booklet describes the "Diamond" steam flue blower and improved turret attachment, explaining the construction and uses, with testimonials substantiating the claims. "You know that you cannot utilize any steam-generating boiler economically unless you keep the flues or smoke passages free of soot. Fire makes soot, and soot being a non-conductor means loss of heat radiation, power, time and money, so the proper thing to do is to clean out the soot as soon as it begins to collect, and to accomplish this purpose the 'Diamond' steam flue blower was devised. The only method prior to the invention of the 'Diamond' steam flue blower was a metal nozzle connected to the steam supply with a rubber or flexible hose. The operator was called upon to open the front doors of his boiler and insert this nozzle in each tube in succession until he had blown through every tube the boiler contained, in an effort to remove this soot, and all the time was endeavoring to work against one of the fundamental laws of nature, namely, trying to blow a light substance against a draft."

Franklin tandem gasoline engine-driven air compressors, made by the Chicago Pneumatic Tool Company, Fisher building, Chicago, Ill., are described in circulars this company is issuing. "An efficient air compressor, running at a high speed, will yield a much greater output of compressed air than is given by a slower running, less efficient compressor of equal weight and size. The increase in actual volume of compressed air delivered by the compressor here described is from 60 to 90 percent greater than is delivered by those of ordinary types with equal cylinder volume. Air compressors, as ordinarily constructed, are limited to moderate running speeds. This is chiefly due to three features of construction: unsuitable air valves, restricted air passages and inadequate water-jacketing. By giving special attention to these features we have developed an air cylinder which will permit a much higher speed than can be attained when using less carefully constructed cylinders. We have also been able to effect a considerable increase in efficiency, and to eliminate the objectionable noise which is usually present even in compressors running at moderate speeds. The advantages of any high-speed compressor are, briefly: Reduced first cost, decreased floor space and less expensive foundation. Our high-speed compressor has the further advantages of high efficiency, quiet operation and economical maintenance."

A marine type of boiler feeder or pressure pump is described in a catalogue issued by Dean Bros. Steam Pump Works, Indianapolis, Ind. "Several years ago this company was called upon to build twelve steam-driven boiler feeders for salt water marine service. It was specified that they should have a certain capacity, be of the highest-grade workmanship and material, and in particular be free from certain faults in design which existed in the best pumps then on the market. These faults caused more or less trouble during long periods of continuous operation. In other words, we were to supply pumping machinery for this service which would be better than the best, and when once started would continue in operation without stopping from any cause within the pumps until the end of the voyage, whether of two weeks or two months. As a result we designed and furnished the Atlantic type pump which is described in this circular. It has filled the requirements in every particular. With certain modifications this type has proved itself especially suitable for power plants where high-grade machinery only is desired. Its capacity for hard, continuous service fits it particularly for duty where there must be no shut-downs. It is intended for working pressures up to 250 pounds gage, and for operation with either saturated or superheated steam. Both for marine and land work our Atlantic type pumps have proved themselves without a peer. These pumps are built with either compound or non-compound steam ends. Either in single units or in pairs. With or without special connecting pipes and fittings."





Superheated steam is the subject of the fifth edition of *Foster Superheaters,* published by the Power Specialty Company, 111 Broadway, New York. The statement is made that those features of the Foster superheater which distinguish its construction from all other types are the result of actual experience in designing and building superheaters, and that they are also checked by careful research into the designs and records of the performance of superheaters for the past fifty years.

A fire extinguisher, especially designed for marine use, has been placed on the market by the Syracuse Chemical Fire Extinguisher Company, Syracuse, N. Y. In a catalogue which the company issues the statement is made that these extinguishers are made under a principle which is entirely different from any others; that the patentee of the Syracuse extinguisher was for many years engaged in the insurance business, so that his experience acquainted him with the defects of many extinguishers now on the market, and the demand for an extinguisher that could be depended upon to operate every time by simply turning bottom up.

Flexible transmission is the subject of bulletin No. 22, published by the Coates Clipper Manufacturing Company, Worcester, Mass. "Coates' unit link flexible shaft is made on the square spheroid principle. A mongrel square drive is the strongest drive known. The squared drive at one end fits in its corresponding socket at the other end, and is so shaped that a universal joint is obtained. A groove is cut at the edge of each socket, and after the square is inserted a spring split ring is inserted, which retains the units and keeps them from pulling apart. To remove a unit a sharp tool or tang of a file is inserted under the ring at the slot, and the retainer is removed instantly. This does away with all rivets of pins and allows the greatest amount of flexibility and efficiency."

The Bergesen steering engine is described and illustrated in a folder issued by the Bergesen Manufacturing Company, 74 Broadway, New York City. "The Bergesen steering engine has a slow-moving piston in a quadrant or arc-shaped cylinder; this piston can be worked by steam, water, air or gas pressure, and its movement is controlled by a new and specially designed valve that is durable and self-adjusting, with a small amount of friction. The valve can be worked by lever or wheel from the bridge or pilot house, or from any other suitable place on the boat or ship. The cross-head of this engine is preferably connected to a similar cross-head on the rudder stock, motion of the engine being transmitted through suitable connecting rods, doing away with rope or chain connections. The engine can also be fitted with a tiller connected direct to a tiller on the rudder head; or tillers and quadrant of suitable dimensions on the engine and rudder head can be connected, and worked by rope or chain. The Bergensen Manufacturing Company builds these machines to suit any position or location on the boat or ship; as, for instance, on the bulkhead up under the deck, on the deck, straddling boiler in tugboats and yachts, under a bunk in the deckhouse, directly on the rudder head, or in other positions. The engine works without a sound, making it desirable for passenger steamers, yachts and torpedo boats. For short and quick work it has no equal. It has no centers or dead-points."

The Gunnell Holder-On—Manitowoc Dry Dock Company, Manitowoc, Wis., writes us: "In view of the fact that there has been a decided demand for an improved air holder-on, we have placed this new tool on the market. It has been tried for some time and found to have features which give it a decided advantage over the old-style single-piston holder-on. It will be seen by the accompanying cut that this device consists of the regular air piston, having mounted on it a rider piston. In the process of riveting with a pneumatic hammer, this tool is used in the usual way, but for each blow struck by the pneumatic hammer, there is a corresponding reaction by the rider piston. It will easily be seen, and has been proven by experience, that this reactive blow lays up the head of the rivet and produces a much tighter rivet than the old-style holder-on. The action is practically that of a hammer on each end of the rivet. In all kinds of structural steel work in which holes are reamed out or pinned, the holes often are not perpendicular to the surface of the metal. The rivet thus inserted diagonally bears only on one edge of the head, and the action of the holder-on simply holds the rivet in this position while it is being driven. The Gunnell holder-on with this reaction piston lays down the head of the rivet just as the pneumatic hammer does the point on the other side of the work. In boiler work this holder-on practically calks the head of each rivet. This holder-on requires the same amount of air to operate it as the solid type, and has a decided advantage so far as the quality of the work is concerned."

The Welin Davit & Lane & De Groot Company, Con., 17 Battery Place, New York, write us: "We are pleased to inform you that during the month of November we booked orders for forty-eight lifeboats, the majority of them being 24 feet in length and upward, and also for a number of rafts, life-preservers, several launches and power dories. We have also recently booked several new orders for equipment of Welin quadrant davits, and would mention the new auxiliary steam yacht *Aloha*, building for Commodore Arthur Curtis James, of the New York Yacht Club, at the yard of the Fore River Shipbuilding Company; the new fine passenger steamer *Alabama*, building for the Goodrich Line, at the Manitowoc Dry Dock Company's yard; the new passenger and freight steamer for the American Hawaiian Steamship Company, building at the Maryland Steel Company's works, and the ocean-going tug, building at the Staten Island Shipbuilding Company's yard, for the Delaware, Lackawanna & Western Railroad Company."

Marine electric heating and cooking are described in a bulletin published by the General Electric Company, Schenectady, N. Y. "The great advantages of electricity in the way of simplicity, safety and flexibility have led to its almost universal adoption as a means of illumination on shipboard, so that to-day even the smallest tugboat has its own electric plant; but shipowners and builders have not as yet fully appreciated its equal superiority as a producer of power and heat. On land the use of the electric motor for power purposes is now as general as electric lighting, and the last few years have seen the beginning of a widespread movement to adopt electricity for heating and cooking as well. Recognizing the vast possibilities in this new application of electricity, the General Electric Company has developed a variety of special devices which have already won such favor that it seems certain they will be as commonly used as the incandescent lamp. As this company has been closely identified from the first with the introduction and growth of electric lighting on shipboard, and has constantly recommended electric power for ship auxiliaries, it now desires to call attention to the very special advantages of electric heating and cooking devices on board ship. A ship's lighting plant, usually of more than ample capacity for its intermittent load, offers at once an available source of supply, which, utilized for cooking in the galley or heating in the staterooms, would provide numerous real and profitable conveniences with small increase in cost."

Mechanical rubber goods for marine purposes are described in a catalogue of 164 pages issued by the Boston Belting Company, 256 Devonshire street, Boston. This is a handsome volume, profusely illustrated in many colors, and describes and illustrates rubber belting, gaskets, pneumatic and other hose, packings of every description, pump valves and a vast number of other mechanical rubber specialties. A free copy of this useful catalogue will be sent to any of our readers who will mention INTERNATIONAL MARINE ENGINEERING.

Fire department supplies, driving apparatus and submarine armor are described and illustrated in a catalogue published by Andrew J. Morse & Son, Inc., 221 High street, Boston. Regarding the Morse Monitor Nozzle the catalogue states that it is the pioneer of all Monitor nozzles. The chamber rotates completely on the base, and hence any desired spot can be reached, and once a stream is directed it will not deviate and the Monitor requires no further attention. This is a feature of great value in all fire protection, as a large number of streams can be attended to by one man and left directed wherever needed. This catalogue also states that since 1872 A. J. Morse & Son have continuously supplied the United States navy with diving apparatus.

The H. & B. steam dryer for all types of marine, stationary and locomotive boilers is described in a catalogue published by Ed. C. Garratt & Company, 102 South Clinton street, Chicago, Ill. "The question of dryer steam for use in steam engines is one that has received much attention from engineers, operators and builders for many years. They all realize that for the development of the highest efficiency of the steam engine, means for eliminating the moisture from the steam must be employed. We find that in many boilers, both stationary and marine, are installed, at considerable expense, so-called dry pipes, baffle plates, separators, etc., which to a certain extent prevent water going over with the steam, but in no case actually preventing priming; some of these even go so far as to retard the flow of steam and cause it to be wire-drawn, which greatly reduces the efficiency of the boiler and engine. The H. & B. steam dryer will supply dry steam without the use of any of these various contrivances, and is highly endorsed by all who are using them. It causes the water which is drawn up mechanically by the current of steam to gravitate before reaching the steam pipe, allowing only dry steam to leave the boiler."

Cranes are described in a handsomely printed and illustrated cloth-bound volume of 262 pages published by the Brown Hoisting Machinery Company, Cleveland, Ohio. In this book are shown merely this concern's standard designs, but the company covers the crane field fully, and is prepared to submit designs and prices on any changes from its standards or on special cranes designed for any particular work.

The boat oars of every description made by the New York Boat Oar Company, 69 West street, New York City, are described in an illustrated catalogue this company has issued. Among the various kinds of oars illustrated are ash sculls and oars, copper-tipped ash sculls, spruce sculls, spruce and ash sculls, spoon sculls and spooin oars, canoe paddles of various types, etc. In addition to this handspikes, capstan bars, mast hoops, etc., are illustrated.

"Real Ventilation" is the title of a booklet just issued by the B. F. Sturtevant Company, Hyde Park, Mass. "The Sturtevant ready-to-run ventilating set was designed to meet the requirement of the United States Government for an apparatus to positively ventilate battleships. It consists of a multi-vane ventilating fan, mounted on the shaft of an electric motor, which obtains its power by means of an ordinary electric cord and plug screwed into any convenient electric light socket. The multi-vane fan is the latest and most efficient type of fan. It is made up of narrow-spooned blades, which give a much greater volume of air than a fan of any other type of construction and the same diameter."

A new and greatly enlarged edition of "Feed Water Filtration" is being distributed gratis by James Beggs & Company, 109 Liberty street, New York. This book explains how oil, dirt, etc., get into feed water, what damage they do within the boilers, and how to remove such impurities before this can occur. It tells how water of condensation and returns from heating systems may safely be used to cut down the coal and water bills, and it explains the advantages and disadvantages of various methods of filtration. Numerous instances are cited where filtration through terry cloth, at the last point in the line before water enters the boilers, has proven successful after other methods have failed. The Blackburn Smith feed-water filter and grease extractor is described in detail. Engineers will find this book well worth writing for.

Row locks of every description are illustrated in a pamphlet published by the New York Boat Oar Company, 69 West street, New York. Special designs are made by this company for every purpose.

The general pump catalogue, published by the Goulds Manufacturing Company, Seneca Falls, N. Y., is a handsome and very completely illustrated catalogue of 332 pages with flexible cloth covers. In spite of the size of this catalogue the statement is made that it lists only a small part of the power pumps that the company builds for heavy service. Every user of pumps should send for a free copy of this catalogue, mentioning International Marine Engineering.

Steam steering engines, tiller steering gears, electric steering gears, hoisting engines, distillers, evaporators, condensers, etc., are described in a 116-page catalogue published by Williamson Bros. Company, Philadelphia, Pa. The catalogue states that the fact that Williamson products have been giving complete satisfaction for many years to users all over the world shows that their standard is high. Regarding the company's hoisting and steering engines the manufacturer can refer prospective customers to many of the largest concerns in the country, some of which have as high as fifty Williamson engines in use. The Williamson Bros. Company has made a specialty of steering engines for twenty years. "The best proof that they have withstood all tests is the fact that certain shipbuilders and owners who have used them continue to re-order year after year."

"Revolution in the Wrench" is the title of a circular published by Rogers, Prinz & Company, Warren, Pa. "It is the wedge principle that makes the Arpeco wrench—a principle so simple, reasonable and powerful when applied to wrenches that you laugh that no one ever saw it before. There are only three parts to the Arpeco wrench—the main handle bar, the shank or lower jaw and the yoke or sleeve. Three powerful and unbreakable parts. You raise or lower the yoke or sleeve by the thumb of the hand which holds the tool, and instantaneously you get the grip of a shark. And the more you wrench, through its wedge construction, the stronger the grip of the Arpeco wrench. There are no springs, no ratchets, no thumb screws, no long-drawn-out measuring of the wrench to the bolt or pipe. The adjustment is instant, and the release just as instant."

"Why Bill Got His" is the title of a cleverly-written story, illustrated by a lot of clever sketches, published by the Coes Wrench Company, 21 Murray street, New York. This is not a catalogue. A free copy of this booklet will be sent to any of our readers who will mention INTERNATIONAL MARINE ENGINEERING.

Air compressors, made by the Union Steam Pump Company, Battle Creek, Mich., are described in a 72-page catalogue this company has just issued. In this catalogue is shown a complete line of the various types and sizes in ordinary use for operating pneumatic tools, pumps, engines, hoists, for sand-blast works, and for all the numerous uses to which compressed air is applied in shipyards, boiler shops, foundries, etc.

A restarting injector, designed for marine and stationary boilers, is described in a vest-pocket catalogue published by William Sellers & Company, Inc., Philadelphia, Pa. The sizes and proportions of these injectors are said to be accurately maintained by having the parts made to a perfect system of gages, so that duplicate parts, which will fit perfectly and give exactly the same results as the original, can always be obtained from the manufacturers.

Condensing machinery is described and illustrated in a 56-page catalogue published by Dean Bros. Steam Pump Works, Indianapolis, Ind. This catalogue describes and illustrates independent air pumps, jet and surface condensers, vacuum pumps, combined air and circulating pumps for stationary and marine engines and all processes where a vacuum is necessary.

Recording instruments are the subject of a number of illustrated leaflets, bound in catalogue form, and published by the Crosby Steam Gauge & Valve Company, 16 Dey street, New York. In these sheets are briefly described a few of the recording instruments the company manufactures, and attention is also called to the vacuum, ammonia and pressure and vacuum recorders which the company manufactures, but which are not mentioned in these plates.

Packings, flue brushes, scrapers and engineers' tools are the subject of catalogue No. 10, issued by the Pilley Packing & Flue Brush Manufacturing Company, 606 South Thirty-ninth street, St. Louis, Mo. A large variety of packings for every possible purpose are described and illustrated in this catalogue, as well as gage glasses, gage-glass valves, expansion flue brushes and many other useful devices. Special attention is called to Pilley packing tools, which will go into any valve, rod, pump or engine stuffing-box.

The Sprague electric hoist, made by the Sprague Electric Company, 527 West Thirty-fourth street, New York, is a labor-saving device, and is designed for the same purpose as the automatic machine tool—to cheapen and increase production. Generally speaking, it is used to handle loads which, on account of their location, are inaccessible to the ordinary traveling crane, or which are too small to be economically handled by such a large and expensive machine. The claim is made that the Sprague electric hoist is made in a greater variety of sizes and designs than any other similar appliance.

"Generating Sets with Compound Engines," "Generating Sets with Horizontal Engines," and "Generating Sets with Vertical Engines," are the titles of bulletins published by the B. F. Sturtevant Company, Hyde Park, Mass. One of these bulletins states that the Sturtevant generating sets, consisting of vertical compound engines, direct connected to generators of eight and ten-pole types, are compact, of high efficiency and capable of sustaining operation for long periods with little attention; that being especially designed to fill the rigid specifications of the United States Navy Department they represent the best engineering practice.

Tools for cutting structural material and other machinery for structural shops, are described in a catalogue issued by the Wiener Machinery Company, 50 Church street, New York. Among the tools listed therein are heavy-duty beam shears of various types and sizes, double-angle shears, coping machines, etc.

Linoleum cements and glues, for attaching linoleum to wooden, steel, tile and concrete or cement floors, are the subject of a circular published by L. W. Ferdinand & Company, 201 South street, Boston. This company's twentieth century linoleum glue-cement is said to be waterproof, ready for use, and not to be affected by heat or cold.

A valuable catalogue of pipe and couplings, wrought fittings, etc., has been published by the National Tube Company. This is a handsomely printed, leather-bound volume of 470 pages, containing several hundred excellent half-tone illustrations, some of them in two colors. There is a very complete index, which adds greatly to the value of the catalogue, which, large as it is, comprises only material manufactured at the Kewanee works of the National Tube Company. We understand that a free copy of this catalogue will be sent to any of our readers who mention this magazine, and write to the general office of the company, Frick building, Pittsburg.

TRADE PUBLICATIONS

GREAT BRITAIN

"The OS Wiring System" is the title of a trade publication issued by Siemens Bros. & Company, Ltd., London, manufacturers of and dealers in all classes of electric cables, instruments, railway and other signaling apparatus.

Messrs. Haslam & Schontheil, Western Mail Chambers, Cardiff, have sent out a catalogue of cast-iron water-tight electric light fittings. These special fittings are suitable for use in marine work and for exposed positions generally. Some types of fuse boxes are also shown.

Messrs. Wailes, Dove & Company, Ltd., Newcastle-on-Tyne, recently issued a booklet showing the various purposes for which their "Bitumastic" specialties may be used. A number of testimonials from users are also given, which show that satisfaction is universal with "Bitumastic."

The Harris Patent Feed-Water Filter, Ltd., of 24 Granger street, Newcastle-on-Tyne, and 82 Victoria street, Westminster, have, we understand, secured a contract for a large water-purifying plant for the Devonport dockyard. The new plant will treat 7,000 gallons of condensed steam per hour.

The Machine Tool Company, Ltd., Northern Works, London road, Nottingham, recently issued a list giving prices and details of new and second-hand machine tools which they have in stock. In addition to machine tools of all kinds the list includes steam engines, pumps, fans and blowers, cranes, foundry plant and other machinery.

Motors and dynamos are described by J. H. Holmes & Company, Newcastle-on-Tyne, in an illustrated catalogue this company has just issued. In compiling this catalogue of continuous-current dynamos and motors, especial attention has been given to the arrangement of the particulars, in order that the outputs, prices, etc., may be ascertained without difficulty.

Pneumatic tools are described in a number of catalogues published by the Consolidated Pneumatic Tool Company, Ltd., Palace Chambers, 9 Bridge street, Westminster, London, S. W. Among the tools illustrated and described are hammers of various kinds, riveters, pneumatic rammers and many other pneumatic devices.

Messrs. Cape & Company, 168 Dalston Lane, N. E., recently issued leaflets containing particulars and prices of their vertical engines using petrol, paraffin, or gas as fuel. These engines are made in sizes varying from 2½ to 10 brake-horsepower. Other leaflets deal with electric lighting sets, Capel's patent regenerator suction-gas plants and suction-gas engines. The lighting sets can be utilized with petrol, paraffin, alcohol and other fuels.

"The Lenthall Course Delineator" is the title of a booklet published by Heath & Company, Ltd., Observatory Works, Crayford, London. "Its extreme handiness, multi-potency and compactness make it a most useful servant to all in charge of vessels, and almost a *sine qua non* to yachtsmen, fishermen and masters of coasters and other small vessels. With it all the problems in dead-reckoning navigation can be accurately solved without the use of books, tables or other instruments. The following problems, which can be accurately and rapidly solved, serve as an illustration: Finding the course to steer a vessel, in order to counteract the effect of a current and to keep her on her true course, and the speed she will make good on her true course. Finding the course and distance made good by a ship after she has sailed various courses and distances. Finding the distance a ship is off a lighthouse or other fixed object, from two bearings, of the same and the distance run between the times of taking the bearings, also the distance the ship will pass off the object when abeam if she keeps on the same course, also the course to steer in order to pass a given distance off the object. To yachtsmen, fishermen and others who have not the facilities for having a chart spread out before them, it is particularly useful when making a crossing from one port to another. With it they can lay off, on a small sheet of paper, the course to the port to which they wish to sail to, and the position of any object they wish to sight, or any shoal or other obstruction they wish to avoid, and can then mark off each tack they make, and see at a glance how they are progressing towards their port of destination, and exactly how far they should stand on each tack. This can be done just as accurately as if they were working on the chart and in a fraction of the time. The instrument is supplied divided either to degrees or one-quarter points as desired, in compact mahogany case, with pencil, book of instructions, giving examples and diagrams, and special ruled pad of fifty sheets."

The Globe Electric Company, Ltd., 11 Farringdon avenue, London, E. C., have issued a descriptive, illustrated catalogue of their electric specialties, among which the "Santoni" flame lamp, which is especially suited for ship lighting, is included.

Temperley Transporters are illustrated and described in a new list of Messrs. Applebys, Ltd., 58 Victoria street, Westminster, S. W. Temperley transporters are practically a combination of crane and conveyor, and are used in all parts of the world for loading and discharging vessels, coal handling, etc. A large number of illustrations are shown of the transporters unloading and storing grain in sacks, raising coal from railway trucks, and carrying out many other duties of which they are capable.

Messrs. Atkinson Bros., Aire Place, Kirkstall road, Leeds, have issued circulars dealing with their specialties; among these a three-speed, electrically-driven sensitive drill is illustrated. This particular tool is produced in three sizes for drilling holes of diameters up to 5/16 inch, ½ inch and 1 inch. Prices of small electric motors and electrically-driven polishing machines are also given. Box-blade fans, ceiling fans and blowers, screwing machines, a motor-driven hacksaw, and a sensitive drilling machine for belt-driving are also dealt with.

Condensing apparati manufactured by the Worthington Pump Company, 153 Queen Victoria street, London, are described in a recent catalogue. The first section of the list relates to jet condensers, and illustrates counter-current and "Conojector" condensers, arranged barometrically or on the low-level system, and also a semi-counter-current jet condenser for small and medium capacities; the latter part of the catalogue deals with multi-flow surface condensers. Each type of condenser is fully described and clearly illustrated, and its advantages are fully set out. Illutsartions of steam and electrically-driven auxiliary machinery for use with these plants are also given.

A pamphlet concerning crane motors and controllers has been issued by Messrs. Dick, Kerr & Company, Ltd., Abchurch Yard, London, E. C. This well-got-up booklet gives details of the construction of the motors, and shows them applied to cranes and hoists. Nine varying sizes are manufactured. The metallic-shield blow-out controller for cranes and hoists is also described. In this controller, coils enclosed in metallic shields are placed with their axes parallel to the cylinder of the controller, near to the points where the arc is formed. The field produced by the coil draws the arc in a direction at right angles to the axis of the cylinder on to the metallic shield, around which it extends itself until it becomes too attenuated to be maintained.

Karl Heineman, of Gothenburg, Sweden, the manufacturer of the "Primus" marine motor, is represented in England by Mr. E. Atkinson Smith, 70 Victoria street, Westminster, S. W. A pamphlet dealing with it has recently been issued. The engine is of the vertical two-cycle type, for use with paraffin or crude oil. A vaporizer is placed on the top of the cylinder, and is heated by a blow-lamp when starting up, but afterwards it is maintained at the right temperature by the heat of the explosions. At the proper point in the cycle, oil is injected by a variable-stroke pump into the vaporizer, where it ignites immediately, and the working stroke follows. The engines are made with one cylinder from 5 to 25-brake horsepower, and a 30-horsepower engine with two cylinders is also listed.

"Eclipse" Electric Cooking Apparatus.—We have recently received a catalogue from the Eelectric & Ordnance Accessories Company, Ltd., Aston, Birmingham, dealing with electric cooking and heating apparatus, constructed on their system. The units consist of a special resistance material insulated with mica, and enclosed in a thin metal casing. We are told that this resistance material is able to withstand a temperature of 2,500 degrees F. without risk of breakdown. That these units are suitable for the purpose may be judged when it is noted that a number of kettles were placed in circuit for periods varying from 500 to 1,250 hours, and at the end of these periods not one of the units had broken down, nor were they the worse for wear to any appreciable extent. These periods correspond to an ordinary use of at least five years. The apparatus the Electric & Ordnance Accessories Company, Ltd., is prepared to supply at present consist of kettles, jugs, glue pots, hot plates, plate warmers, flatirons, curling tong heaters and cigar lighters. These latter, by the way, consist of a miniature arc lamp, which is brought into action by pulling the chain at the side, and we should think it would be extremely useful for entrance halls of hotels, clubs and for tobacconists' shops.

Electric switch gears are described in an illustrated catalogue of 25 pages, published by J. H. Holmes & Company, Newcastle-on-Tyne.

Hall's patent frictionless governors are described in a list issued by Messrs. Charles Winn & Company, St. Thomas' Works, Granville street, Birmingham. This kind of governor is suitable for all kinds of steam and gas engines, and is made in eight standard sizes, for speeds varying from 150 to 400 revolutions per minute. Prices of each size are given in the catalogue.

Messrs. Royce, Ltd., Trafford Park, Manchester, have issued an excellent catalogue showing some of their specialties. These lines include overhead cranes, capable of taking up to 100 tons; Goliath cranes, cantilever, walking and jib cranes, electric transporters for overhead runways, and also electric winches and capstans. Most of the illustrations shown are from photographs, which depict the cranes, etc., in actual work.

A card of tables and calculations, suitable for engineers, has been published by the Unbreakable Pulley & Mill Gearing Company, Ltd., Hyde Road Engineering Works, West Gorton, Manchester. The tables give the horsepower transmitted by steel line shafting and the required pitch of bearings, the rim speeds of pulleys of various diameters at various numbers of revolutions are shown, and also the horsepower transmitted by single and double-leather belting at different speeds.

The British Welding Company, Ltd., 25 Victoria street, Westminster, S. W., have issued a booklet illustrating some of their specialties. Among these are steel pipes from 15 inches to 6 feet in diameter, and in lengths up to 52 feet, welded boilers and digesters, cylinders, gas chambers for buoys, etc. A sparate leaflet deals with welded steel pipes, with spigot and faucet joints.

Messrs. Stork Bros. & Co., Hengelo, Holland, have issued a catalogue giving particulars, prices, etc., of their low-lift centrifugal and turbine pumps. Tables of dimensions and capacities are given of 3-inch to 14-inch pumps, with belt or electric drive, for heads up to 20 metres (65 feet 7 inches). Particulars are also given of some very compact steam-driven centrifugal circulating pumps for surface condensers. These are made with 4-inch, 5-inch and 6-inch outlets.

Standard compasses, with a description of the principal patterns and the essentials of a reliable compass, is the title of a booklet published by Wilson & Gillie, nautical booksellers, the New Quay, North Shields. This booklet makes decidedly interesting reading for all users of compasses, and is profusely illustrated with illustrations taken from the patent specification by permission of the Comptroller.

Gold dredgers, river steamers and other vessels are described in a catalogue issued by Mr. Arthur R. Brown, A. M. Inst. C. E., 54 New Broad street, London, E. C. The gold dredgers are built to the designs of Messrs. Cutten Bros., of New Zealand and London, and the catalogue illustrates a number of dredgers with bucket capacities varying from 1½ to 6 cubic feet. Several vessels are illustrated by excellent reproductions from drawings and photographs, and among these are included screw and stern-wheel steamers for tropical rivers, cargo steamers, tugs, lighters, launches and motor boats.

A catalogue of diving apparatus and submarine appliances has been issued by Messrs. Siebe, Gorman & Company, Ltd., 187 Westminster Bridge road, London, S. E. The firm's well-known air pumps, diving helmets and dresses, diving bells and accessories, including electric lamps, telephone apparatus, pneumatic tools, exploders for blasting, etc., an interesting self-contained breathing apparatus, capable of being used as a smoke-helmet or for diving in shallow water, is described and illustrated. This consists of a helmet and jacket, and in a pocket is a substance which, in contact with the respired water vapor, gives off pure oxygen. The residue is an alkali, which absorbs carbon dioxide, so that the air contained in the apparatus can be breathed over and over again, and light work can be carried on for about an hour with one charge.

Harrison patent steam steering gears, windlasses and capstans are the subject of catalogue No. 25 published by Alexander Turnbull & Company, Ltd., Glasgow. This is a profusely illustrated volume which should be in the hands of all users of marine auxiliary machinery. The catalogue states that the Harrison patent steam steering gears have been fitted to over 5,000,000 tons of shipping, including His Majesty's battleships, cruisers, torpedo boats and destroyers; to the war vessels of foreign governments, and all vessels of the merchant marine of every description, including Atlantic liners, cargo boats, river steamers, ferries, etc., and that the efficiency and reliability of these gears have secured their use by nearly all of the most important steamship companies throughout the world.

BUSINESS NOTES

AMERICA

NEW BUFFALO MOTORS.—In addition to the heavy duty and speed types on which the Buffalo engines have based their claim of "an engine for every size and sort of boat," the Buffalo line, built by the Buffalo Gasolene Motor Company, Buffalo, N. Y., will add to its long list two new engines for 1910. These are an improved V-type eight-cylinder, high-speed engine, giving extremely high power in concentrated space and the sought-for and valuable advantage of a much lower center of gravity than any other type of engine affords, and a four-cylinder, 4¾ x 5, high-speed engine, which will give a speed engine of a size smaller than the present 60-horsepower Buffalo speed engine, and which is destined to turn runabouts and medium-sized launches and racers into much faster boats. In a word, these two new Buffalo speed engines will add one to either end of the present line of Buffalo speed engines, making the assortment for 1910 consist of the four-cylinder, 4¾ x 5; the four-cylinder, 6¼ x 6¾, 60 horsepower; the six-cylinder, 6¼ x 6¾, 90 horsepower, and the new V-type, eight-cylinder, planned as a concentrated power plant for the speediest of racers. The new Buffalo V-type has been given the same careful designing and testing, and has had embodied in it all the improved applications of safe and sane marine practice that has characterized the other engines of the Buffalo line.

TO USERS OF MARINE GLUE.—"Do not be deceived by cheap imitations. The slight difference in cost between the best and the cheapest is nothing compared with the cost of doing the work over again. Our extra quality genuine Jeffery's patent marine yacht glue is the cheapest in the long run for paying seams of decks. Because, first, its peculiar properties are those of flexibility and durability, and although it becomes soft and pliant under heat, it still retains its adhesion to timber, fibre, etc., and does not stick to the feet in hot weather. Second, this glue is much lighter in weight than the lower-priced qualities and therefore goes farther. The cheap glue is very heavy and will not pay so many feet of seam per 100 pounds, neither is it as elastic and clean. Fourteen pounds extra quality yacht glue will run from 200 to 250 feet of seam ¾ inch deep by ¼ inch wide. If properly used and not overheated, it will last four to six years in a seam, and has been known to last ten to twelve years. When carefully applied to a dry deck it will never leave the sides of the seam. Third, it is acknowledged by all to be the best, as thousands who have used it stand ready to testify. Fourth, if you must use cheaper glue we can furnish it in the various qualities from .. cents per pound upwards. Fifth, you are trying no experiment when you use this glue. It has stood the test for over half a century, and is used exclusively by such concerns as Herreshoff Manufacturing Company, Geo. Lawley & Sons Corporation. Send for samples, specimens, circular and price list to L. W. Ferdinand & Company, importers and sole agents for United States and Canada, 201 South street, Boston, Mass., U. S. A."

BUSINESS NOTES

GREAT BRITAIN

"A SMART ENGINEERING TURN has just been performed by Bull's Metal & Melloid Company, Ltd., Yoker. The owners of the Allan liner *Grampian* recently required a new bronze blade, but could only allow four days for the complete work. Bull's Metal Company received the pattern on a Tuesday at 3 p. m., and by 3 a. m. on Saturday they had this heavy blade completed ready for the boss. The work naturally included moulding of the blade, drying of the mould, pouring same, cooling the casting without artificial means, detaching dead-head, removing 3½ cwts. of metal in turning, facing, drilling, and scooping out center, as well as finishing off edges and dressing of surfaces. Six hours were lost by small accidents and stoppages. It is believed that this repair easily breaks all records of the same kind. In order to execute repairs to bronze propellers in the most expeditious and careful manner, Bull's Metal Company has fitted a furnace sufficiently large to give room for the whole propeller blade up to the flange or boss. The blade under repair is slowly brought up to a red heat in this furnace, and thereafter straightened and formed to correct shape and pitch by squeezing, wedging, or screwing, without hammering. A recent heavy repair of this kind was made to three badly damaged blades of another liner, which vessel subsequently made a record passage with these repaired blades."

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

For Sale.—Library of technical and theoretical books on naval architecture and shipbuilding, in whole or per volume. Address *Library*, care International Marine Engineering.

For Sale.—Volumes 6 to 16, inclusive, of *Transactions of Society of Naval Architects.* In good condition. Address *Box 21*, care International Marine Engineering.

Inventor of patent telemotor wishes to communicate with firm who would take up manufacture. British and American patents. Address *Telemotor*, care International Marine Engineering.

Wanted.—One copy each of International Marine Engineering for February and March, 1907. Address *Engineer*, care International Marine Engineering, 17 Battery Place, New York.

The engine and boiler works of David Rowan & Company, 231 Elliot street, Glasgow, were established by the late Mr. David Rowan, on their present site, when the *Great Eastern* was laying the first Atlantic cable. The latest extension of the works covers the site of the old Lancefield forge, where the crankshafts of the *Great Eastern* were forged. At the time of the establishment of this business Mr. Rowan possessed a wide reputation as a builder of paddle engines, which was the type almost universally adopted in marine work. The first job turned out by the young firm included, in addition to a ship's engines, the boiler, which was constructed of steel plate, then a great rarity. The ingots for the plates were cast in a foundry in the north part of the city and were sent to the then Glasgow Iron Company, to be rolled. The proprietors of the iron works were so afraid of the new material that they delivered the scrap along with the plates in order that the evil youngster should not get mixed with the time-honored and respected iron. This incident is interesting, as it shows how the most common material of to-day was regarded forty years ago, and indicates the changes which the business established by Mr. Rowan has undergone in developing one of the largest and most modern marine engine and boiler works on the Clyde

For twenty years Mr. David Rowan remained the sole proprietor of the gradually expanding business, but in 1885 his eldest son, James, was admitted as a partner, and he gradually took over the general management of the firm, its operation expanding rapidly under his energetic direction. In 1898 the founder of the business died, and there then came into the partnership the present head of the firm, Mr. William Thomson, who had been manager since 1890. During the next few years the works were completely reorganized and greatly extended, and they now occupy a floor space of four acres, all of which is completely roofed in. The reorganization naturally carried with it re-equipment. The shops were completely refitted with tools and machinery of the most modern and up-to-date type. In 1906 Mr. James Rowan died, leaving Mr. Thomson sole partner, and two years later Mr. Thomson took into partnership Mr. J. Graham Young, Mr. William Todd and Mr. William Weir, all of whom had been associated with the firm for a number of years. In a firm which had been so long established, it was natural that during the reconstruction and expansion all the weak points in the design and workmanship of marine boilers and engines should be thoroughly investigated and methods adopted to eliminate all defects. This was most carefully done, resulting in the highest class workmanship and design. For instance, in all boiler and plating work every care is exercised to make the fits particularly fine, and it is to this care that Messrs. Rowan & Company owe much of their success in boiler making.

The capacity of the engine shops is now about twenty-six sets of engines per annum, averaging from 2,300 indicated horsepower each, the sizes ranging from the smallest up to 5,000 and 6,000 indicated horsepower, or a total output of about 60,000 indicated horsepower per annum. One important feature in connection with the management of the works is the premium system, known as the Rowan premium system, which has had the direct effect of securing the maintenance of a high standard of workmanship in all departments, and which is a distinct advance in the management of engineering works.

Among other work carried out by Kelso & Company, opticians, electricians, and model makers, 1008 Pollockshaws Road, Glasgow, is the making of equipment and apparatus for experimental model towing tanks. The business carried on by Kelso & Company was established in 1871, in Jamaica street, Glasgow, by Mr. M. G. Kelso, optician and philosophical instrument maker. As the business increased, the works moved to Oswald street, then to Bothwell and Union streets. At this time the work of ship model-making was undertaken, together with the manufacture of the various small articles that go to make up a finished model. These models were made from drawings or catalogues, and were generally to a scale of ¼ inch to the foot, often to the scale of ⅛ inch or 1/16 inch to the foot. As the business rapidly increased, the works were moved to Commerce street, Southside, where a large work shop, with a top flat and warehouse and office on the top floor of the works, was acquired. Here experimental tank work for the Russian and Italian Admiralties was carried on. The firm was again forced to move on account of fire, and quarters were hastily acquired in Oxford street and continued there for twelve years. At the end of that time the present commodious three flats, each measuring 100 by 25, with good light and air, were acquired. In the Oxford street premises, complete sets for experimental tank work for Messrs. John Brown & Company, Ltd., and the Mitsu Bishi Company, Nagasaki, Japan, were completed.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

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TRADE PUBLICATIONS.

AMERICA

A grease-extracting feed-water filter for marine and stationary engines is made by the American Steam Gauge & Valve Manufacturing Company, Boston, Mass., and is described and illustrated in a catalogue that company has just published. Among the advantages claimed for this feed-water filter, are that it has a filtering surface equal to 320 times the area of the feed-water pipes; that it has the simplest and quickest of all methods of making renewals; a device for applying a reverse current of steam and making temporary cleaning. It is light, but strong and durable; easy and quick to clean; cheap to maintain; economical of space; simple in design, moderate in cost. Filters are furnished in cast iron or bronze. An extra set of cloths is furnished with each filter.

Reducing and regulating valves for steam, water and air are described in circulars distributed by the Ross Valve Company, Troy, N. Y. "Their operation may be described as follows: Steam or other fluid being admitted from boiler or pipes having a high pressure will pass freely through the valve, which is held open by the compression or tension on the loading spring until the pressure in pipes on the outlet side is sufficient to overcome the tension of the loading spring. Low-pressure is admitted from the outlet side of the valve through the stem, and operates below the movable piston or flexible diaphragm; the valve gradually opening or closing with any slight rise or fall of pressure on the outlet side. Variation of pressure in boiler or in the supply pipe has no influence on the valve, as two equal areas are exposed to the pressure on the high-pressure side."

"Insulation of Pipes and Boilers" is the title of an illustrated pamphlet printed by H. W .Johns-Manville Company, 100 William street, New York. To determine the saving that can be made by the use of efficient pipe covering, Mr. George H. Barrus, a well-known engineer, conducted a series of tests, the results of which were published in the official publication of the American Society of Mechanical Engineers. These tests show that a saving of 85 percent in coal can be effected by properly insulating bare pipes. "Tests made by prominent engineers show that steam at 350 degrees F. can be conveyed through pipes insulated with J-M covering for a distance of 5,356 feet through a temperature of 60 degrees, with a loss of only 10 horsepower (or 2.65 percent) of a 375-horsepower engine carrying 120 pounds of steam. Another desirable feature of J-M pipe coverings, and one appreciated particularly by engineers, is that they materially reduce the temperature of engine rooms."

The oxhydric process for the cutting and welding of metals is described in a catalogue issued by the American Oxhydric Company, Milwaukee, Wis. "This process is based on the well-known fact that metals made intensely hot burn easily and rapidly in an atmosphere of oxygen gas. If we throw a jet of oxygen upon iron that has been brought to a red heat, the oxygen oxidizes the metal—that is, burns it. Iron heated to from 1,300 to 1,500 degrees F. has a wonderful affinity for oxygen, and instantly combines with it to produce various forms of oxides. A great deal of experimenting in the line of cutting has been done, and the great difficulty seemed to be that the oxide of iron, not being hot enough, lacked fluidity, and was, therefore, difficult to eliminate, as it mixed itself with the partially melted iron and stopped combustion. The workmen, even when very skillful, obtained only a very irregular and unclean cut, the borders of which consisted of sticky oxides, which were hard to remove."

Fuel economizers and air heaters are the subject of Catalogue No. 150, published by the B. F. Sturtevant Company, Hyde Park, Mass. This catalogue describes the Sturtevant new high-pressure type economizer, which has all joints metal-to-metal, and which will stand working pressures up to 300 pounds per square inch. Gasket joints are done away with, thus eliminating the chance of leakage. Moreover, with the Sturtevant design of positive scraper mechanism the scrapers cannot stick or bind, thus eliminating many of the troubles frequently found in economizers. This catalogue shows not only the designs and gives the dimensions of the economizer, but also shows examples of the investment returns, so that it should be of great interest to engineers, manufacturers and owners. The principle of this economizer is to conduct hot waste gases which have passed through the boilers, and are escaping into the chimney around and between a system of cast iron pipes containing feed water, thus heating a large volume of water to a high temperature before it enters the boilers, accomplishing all the saving in fuel and gaining this extra boiler capacity by the use of otherwise wasted gases.

Measuring instruments of precision are the subject of Catalogue No. 7, published by the John M. Rogers Boat, Gauge & Drill Works, Gloucester City, N. J.

Continuous-current, direct-driven, type S generators for lighting and power are described in illustrated Bulletin No. 110, published by the Sprague Electric Company, 527 West Thirty-fourth street, New York.

A handsome calendar has been sent out by the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio. It is the first of a series of twelve subjects by Stuart Travis, which will be sent out monthly during the coming year. Any one of our readers may obtain a copy by writing the Falls Hollow Staybolt Company and mentioning this magazine.

The boiler trimmings made by the Detroit Lubricator Company are the subject of a folder issued by that company. This concern's water gages, fusible plugs, compression gages, cocks and expansion tank trimmings are said to be a line made from an entirely new equipment, and to be made up with the same care and finish as the Detroit lubricators.

"About a New Wrench" is the title of a booklet sent out by Rogers, Printz & Company, Warren, Pa. According to this catalogue the wedge feature in these wrenches eliminates all of the objectionable features to be found in other wrenches, and it is stated that the simple raising or lowering of the yoke or sleeve by the thumb of the hand holding the tool gives an instantaneous grip. This wrench has no springs, ratchets or thumb screws.

Rubber-covered wires and cables are described in a handsome catalogue, printed and illustrated in two colors, published by the Diamond Rubber Company, Akron, Ohio. This catalogue states that the manufacture of rubber for insulating purposes presents a subject in which scientific skill and knowledge produce marked results. Any rubber will act as an insulator, but the rubber, which has been skillfully prepared, will show a greater resistance than that which has not.

The marine engines made by the Brown-Talbot Company, Salem, Mass., are described in a catalogue which the company has just published. The catalogue states that after five years spent in the manufacture of internal-combustion engines for marine work, the Brown-Talbot Company now offers an entirely new line of models; a line in which there has been incorporated the results obtained from five years' experience and the thorough research and comparative tests made by its engineering department.

Tools for punching and shearing structural shapes, sheets, plates, flats, bars, etc., are described in a catalogue published by the Schatz Manufacturing Company, 14 Fairview avenue, Poughkeepsie, N. Y. These machines, according to the catalogue, are the result of experience in this especial branch extending over a period of thirty years, and they are stated to be unrivaled for efficiency, solidity, reliability, capacity and simplicity of operation.

A convenient pocket diary and memorandum book will be sent free to all readers of INTERNATIONAL MARINE ENGINEERING, by the Welin Davit and Lane & De Groot Company, 17 Battery Place, New York. In addition to the many pages devoted to the diary and to other purposes, the book contains calendars for the years 1910 and 1911, and tables of percentages and interest, populations of leading cities, distances, colored maps of all parts of the world, brief business laws, weights and measures, what to do in case of accidents, etc.

The Lagonda Manufacturing Company, Springfield, Ohio, has just published an interesting pamphlet entitled "Scale and the Vacuum." This describes some of the new cleaners especially suited for removing scale from the tubes of surface condensers, ammonia condensers, etc., which the company has recently developed. It also contains valuable tables showing the losses in horsepower resulting from the reduction in vacuum, due to the formation of scale in condenser tubes. Copies will be supplied free upon request to readers of INTERNATIONAL MARINE ENGINEERING.

Forsyth braided hose, for air, water, steam, gas, oil, etc., is described in a little book issued by the Boston Belting Company, Boston, Mass. This booklet states that a hose in which the fabric is seamless and circular woven or braided has long been recognized as the strongest and, in many respects, the most desirable form of construction. The Forsyth braided hose is offered as the most improved and perfect hose of the kind now on the market. Over a seamless rubber tube are braided one or more piles of seamless fabric, each one of which is thoroughly coated with rubber, and there is the usual rubber covering on the outside.

TRADE PUBLICATIONS

GREAT BRITAIN

Royce, Ltd., we understand, have booked orders for two 45-ton overhead electric cranes for Canada, two 125-ton electric cranes for a Japanese dockyard, and twenty-three electric capstans for the Clyde Navigation Trustees, fourteen of the latter being of the Royce patented free-barrel type.

Messrs. Lancaster & Tonge, Ltd., Manchester, have issued a circular giving full particulars and illustrations of their well-known "The Lancaster" patent limit rings. These rings have been subjected to special tests at high-pressures, speeds and superheats, and have proved satisfactory in all cases.

The Darlington Forge Company have the honor of making the largest stern for a steamship designed. This was made for the White Star liner *Olympic*. It weighs 70 tons, and measures 68 feet long by 22 feet wide. The traffic on the North-Eastern Railway was held up in order to take it from Darlington to West Hartlepool.

Waygood & Company, Ltd., Falmouth Road, London, have issued a list of their cranes and hoists worked by hydraulic and electric power; cranes for harbors, wharves and warehouses are included; illustrations are given of a hydraulic wharf crane with patent luffing and water-saving gear, wharf cranes with patent luffing jibs, electric gantry cranes for wharves.

River steamers, dredgers, tugs, lighters, motor launches, engines, boilers, etc., are the subject of a handsomely illustrated catalogue published by Arthur R. Brown, 52 New Broad street, London. Among the interesting photographs of some of this company's steamers are those in use on the Amazon River, in Central America, Brazil, India, Africa and other parts of the world.

The "Sarco" patent feed-water weigher is described in a pamphlet published by Sanders, Rehders & Company, Ltd., 108 Fenchurch street, London, E. C. "Viewed from the standpoint of position, there are two principal types of water meters—those between the feed pump and boiler, and those on the suction side of the pump. For several reasons it is a more attractive proposition to many engineers to measure their water at the pressure and temperature at which it enters the boiler, and a water meter which would perform this work with accuracy and without requiring frequent repair or renewal would, no doubt, find wide adoption. However, these qualities are not easily united in practice. We believe we may safely say that it is now an established and indisputable fact, that the conditions under which a pressure meter has to work are so severe that to meet them, even in some degree, a very heavy and expensive mechanism is necessary. Such mechanism cannot be absolutely accurate even at a constant rate of flow, and must be subject to considerable error when this rate varies within wide limits. Moreover, the high temperatures frequently encountered, and the fact that the feed pumps are almost invariably subjected at times to very considerable overloads (for which provision is seldom made when the meter is bought), render breakdowns frequent, and the upkeep of such a meter a very heavy item. It is for these reasons that water meters are not usually used for official tests, and the same considerations have prevented many steam users from installing them. What, then, is the correct method to adopt? The reply which would probably be made to this question by any engineer of experience is—that if accuracy is required the water must be weighed in tanks. This, indeed, is the best present-day practice. That it is not an ideal method of keeping a constant check on the amount of water evaporated needs no particular emphasis from us. Everyone knows that tanks and weigh-bridges are cumbersome and expensive; that two experienced men are required to carry out such a test, and that it cannot be run continuously. But as it is admitted that weighing every ounce of water pumped into the boiler (or returned from the condensers) is the only universally acceptable method, we may be permitted to assert that the new 'Sarco' water meter, described below, which will do just this work, viz.: weigh every ounce of water, successfully solves the question of continuous-feed water measurement. Of course, it is not possible to weigh water under boiler pressure, and this meter, therefore, belongs to the group which have their place on the suction side of the pump. It differs from all others of this category, not only because it weighs all the water passing through the pipe in question, but also because it is smaller for a given duty, more accurate, and has no complicated working parts. The prices compare very favorably with those of any other feed-water meter or air pump-discharge recorder."

Iron and steel tubes and fittings of all kinds and sizes, for gas, steam, water, compressed air, heating and refrigerating purposes, etc., are described in a folder published by John Spencer, Ltd., Wednesbury, Staffordshire.

The "Suckling" watertube boiler, made by Hawksley, Wild & Company, Ltd., Brightside Boiler Works, Sheffield, is the subject of illustrated catalogues this firm has published. "The Suckling watertube boiler, owing to its simplicity, perfect circulation, free and easy liberation of steam, excellent position of its heating surfaces, and consequent high efficiency, is rapidly displacing some of the older and more or less faulty boilers of this class. The special advantages of this boiler will be readily apparent to all those who have had experience with other types of watertube boilers, where the imperfect circulation and accumulation and incrustation of deposits in the confined water spaces and tubes immediately over the fire have been the cause of so much trouble."

The Power-Gas Corporation, Ltd., of Stockton-on-Tees, has recently issued a new catalogue of Mond gas plant. Some alterations have recently been effected in this which have enabled the Corporation to offer it at a lower figure. Practically any kind of fuel can be gasified in a Mond plant, and in some instances the gain from the by-products is so great that the gas produced costs nothing. A large electric plant is now, we understand, being erected by the German Government, which will be worked entirely by peat gas, as peat is particularly suitable for this plant. In addition, the catalogue contains information relating to the use of gas for heating or power. The Power-Gas Corporation will be pleased to send a copy of their catalogue to any firm interested.

Messrs. Tangyes, Ltd., Cornwall Works, Birmingham, have issued a well-got-up catalogue showing their "T" type gas-engine, and also suction-gas plants. The engine is supplied in two series—one built for electric lighting and other work requiring very steady running, and the other for general purposes. It is made with either one cylinder or with two cylinders coupled side by side, the capacities of the single-cylinder type varying from 35 to 216 brake-horsepower. Governing is on the "variable admission" system, so that there is an impulse in every circle, even at no-load, and ignition is effected by a low-tension magneto with variable timing device. An illustrated list of duplex and other pumps, either belt-driven or geared to oil engines, has also been issued by Messrs. Tangyes.

Chain drives are described in a catalogue published by the Westinghouse Brake Company, Ltd., 82 York Road, London. "So great has been the extension of our chain business that we are again obliged to issue a new pamphlet. When we secured the manufacturing rights five years ago, and built the comprehensive chain works at King's Cross, we were confident of the appreciation with which the rocker-joint chain drives would meet. Now we admit that our expectations have been far exceeded, not only in regard to actual turn-over, but in the variety of purposes for which our chain drives have proved themselves to be the most suitable power transmitters. We have in operation drives ranging from ½ to 500 horsepower in all manufacturing centers of the world. We have equipped numerous kinds of direct-driven machine tools, line shafting, steel mills, air pumps, engine governors, calendar rolls, feed motions, crane motions, pleasure cars, motor omnibuses, turbine fishing yachts, paddle steamers and other types of marine propulsion, while more recently we have supplied our chain drives for aeroplanes and dirigible air ships; in fact, we are furnishing these drives for every kind of high-speed power transmission."

Messrs. S. T. Taylor & Sons, Scotswood, Newcastle-on-Tyne, in addition to being on the Admiralty list, have quite recently been placed on the War Office list in connection with their "Tynos" non-conducting specialties.

"Melloid" white metal, "B" quality, for the lining of bearings, is an alloy made by Bull's Metal & Melloid Company, Ltd., Yoker near Glasgow, and is stated in a circular issued by that company to give satisfaction when exposed to extreme wear and heating, as in marine bearings, eccentrics, etc.

Messrs. Simpson, Strickland & Company, Ltd., of Dartmouth, state that Mr. F. C. Simpson, who has taken no active part in the business of the firm for a number of years past, has now definitely retired, and that the vacancy on the board of directors has been filled by the appointment of the present works manager, Mr. J. E. Cooper.

Compound surface condensing marine engines for yachts, launches, tugboats, etc., are described in circulars published by W. Sisson & Company, Ltd., Gloucester. These engines are suited for 160 pounds water pressure, or up to, say, 200 pounds, if required, and are provided, when desired, with a suitable boiler and all accessories, making a complete set of machinery all ready for fixing on board.

BUSINESS NOTES

AMERICA

SAMPLES OF FIRE HOSE, submitted with bids after January 1, according to an agreement made by all fire hose manufacturers, shall not measure over 6 inches in length.

TUNGSTEN LAMPS IN A WRECK.—A collision between the Pennsylvania passenger train and an empty engine, at Jersey City last November, damaged the engine and cars considerably. One of the steel passenger coaches jumped the track and turned over on its side, bending one of its steel plates about 18 inches. In the lighting equipment of this car were nine Tungsten lamps, made by the General Electric Company, Schenectady, N. Y., and we are informed that after the wreck, when all the lamps were taken out and tested, the Tungstens were found to be in perfect condition, a proof of the remarkable strength and durability of these lamps.

NEW NEW YORK CITY BRANCH FOR BUFFALOS.—In keeping with their broad business belief that their responsibility as engine builders does not cease when they have sold an engine, the Buffalo Gasolene Motor Company, Buffalo, N. Y., builders of Buffalo engines, have changed their selling agency in New York City to a branch office, to give closer and better service to the hundreds of Buffalo users in the Metropolitan district. This will provide a more intimate and direct business relation between the maker and buyer. The selling agency for Buffalos for the Metropolitan district has been taken out of the hands of the Motor Boat Supply Company, at No. 107 Liberty street, and a Buffalo Gasolene Motor Company branch opened at 1035 Terminal building, No. 30 Church street, with Mr. W. S. MacLeod in charge as branch manager. Mr. MacLeod is an exceptionally proficient engine man. For three years he was the agent for Buffalos at Washington, D. C. His new territory will include the State of Connecticut beside the Metropolitan district, which takes in Long Island, the Hudson River and the New Jersey coast. The Buffalo Gasolene Motor Company is now enabled to give its generous home office service to all Buffalo users or buyers in this territory.

THE EUREKA FIRE HOSE MANUFACTURING COMPANY recently sold 2,000 feet of Red Cross fire hose to the city of Newburg, N. Y., at the price of 90 cents foot, coupled. An item in a local paper stating that the city had bought "Paragon" hose at 90 cents has been copied in a number of papers throughout the country. The Eureka Fire Hose Manufacturing Company wishes to say that "Paragon" hose is never sold at less than the standard price of $1.00 per foot.

VESSELS CLASSED AND RATED by the American Bureau of Shipping, 66 Beaver street, New York, in the *Record of American and Foreign Shipping:* American screw, *Capt. James Fornance;* American screw, *Capt. Gregory Barrett;* American screw, *Advance;* American screw, *Evelyn;* American screw, *Baltimore;* American screw, *Carolina;* American screw, *Melrose;* American screw, *Malden;* American screw, *Everett;* American six-masted schooner, *Wyoming;* American schooner, *G. J. Cherry;* American schooner, *Frances M.;* American tern, *Lizzie E. Dennison;* American tern, *Herald;* American tern, *Willie H. Child;* British tern, *Wilfrid M.*, and British barkentine, *Emma R. Smith.*

THE FIRST ALL-AMERICAN EXPOSITION ever held in a foreign country will be the American Exposition to be held in Berlin in June, July and August of this year. Unlike a world's fair, where a large percentage of the visitors are merely sightseers and exhibits are lost in a maze of many buildings and amusement resorts, this exposition will appeal to the business men of Europe, who will want to see what Americans are doing. The official catalogue of the exposition will constitute a permanent record of the exhibitors and their wares, which progressive dealers and importers the world over will naturally consult in looking for new connections or in placing orders. There will be no customs duties, and exhibits will be entitled to a 30 percent ocean freight reduction both ways. For those who do not care to send a representative of their own to Berlin to install and demonstrate their exhibits, the management will provide, through a sales office and a bureau of information, established in the Palace, the service of competent men, who will devote their entire time to such exhibits. Beyond packing the exhibits at their factories, therefore, manufacturers will be relieved from all further trouble in connection with their exhibits. Full particulars may be obtained by applying to "Headquarters of the American Exposition, 50 Church street, New York."

MR. C. N. MANFRED, for several years manager of the advertising department of the H. W. Johns-Manville Company, 100 William street, New York, has resigned to become secretary of the Willett Press, New York City.

WILLIAMS' "VULCAN" AUTO TOOL.—Convenience, service and wear are assured in this combination. The tools are drop-forged from carefully selected steel, milled and ground to correct sizes of openings, tempered, polished and blued. It is a veritable "half-pound" tool chest, replacing a dozen ordinary tools. Its usefulness and efficiency extend to all mechanical purposes—a thorough household, motor boat, etc., etc., tool. They are packed in canvas bags with button flap, and become an unusually adaptable hip-pocket companion; 8 inches length and ½ pound weight. Retailed everywhere at $1.00 each. Sold to dealers only, in not less than 1 dozen lots.

JAPANESE INSTITUTION OF NAVAL ARCHITECTS.—The annual meeting of this body, which includes alike those responsible for naval and for merchant ship designing in the Island Empire in the Far East, took place in November, and was well attended, both in its business proceedings and in the social gathering that followed. Four papers were read at the former, the titles and authors as follows: "On the Development of Fishing Boats in Japan," by S. Cato, M. E., inspector of fishing boats for the Imperial Fisheries Bureau; "On Lloyd's Rules, their Development and New Departure," by J. Imaoka, M. E., naval architect to the Marine Bureau, Department of Communications; "On Lloyd's New Rules," by F. P. Purvis, professor of naval architecture Tokio Imperial University; "On the Oil-Burning Arrangements of Tenyo Maru and Chiyo Maru," by Dr. S. Terano and Baron Shiba, professor of naval architecture, and professor of marine engineering (respectively), Tokio Imperial University.

A NEW BOILER COMPOUND COMPANY has been formed to manufacture and compound chemicals for boiler treatment. Nearly all the men identified with the new firm have given up remunerative positions elsewhere. The new organization, which is incorporated under the name of Green, Hook & Company, with its main office in the Hudson Terminal building, New York, is also operating its own branch offices in Boston, Philadelphia, Baltimore, Norfolk and Havana. Other offices will be opened as fast as capable representatives can be found. The main laboratory and works are in Jersey City, N. J., and another is under construction in Baltimore. Financially the company is backed by Jacob W. Hook, president Old Town National Bank, and owner of Jacob W. Hook & Company, and C. Howard Hook & Company, manufacturers and dealers in oils, greases, etc., of Baltimore, and Stanley K. Green, of New York. The executive end of the business will be largely in the hands of Stanley K. Green, formerly sales manager of the George W. Lord Company, which company made a specialty of stationary boiler compound business. Until recently Mr. Green was in a similar capacity with the Bird-Archer Company. Mr. Green's practice and experience cover both stationary and marine boiler conditions. He has observed and tabulated the results from the use of boiler compound in thousands of various analyses, noting the actual working conditions within boilers, and the effects of powder, extract and liquid compounds in each formula. The Jersey City laboratory is in charge of John Barnes, late with the Bird-Archer Company, and said to be the originator and patentee of mercury compounds for marine and stationary use. With Mr. Barnes is his son, George W. Barnes, who for a long time has assisted his father in the factory of the Bird-Archer Company. The Baltimore laboratory, when completed, will be in charge of Chester W. Ahlum, F. C. S., late chief chemist of the George W. Lord Company, and now consulting chemist of Green, Hook & Company. With the New York office are H. E. Chapman, ex-chief engineer of the American liner *New York*, formerly chief engineer of the power plant of Harlan & Hollingsworth, Wilmington, Del., and superintendent of the Jersey Central Railroad repair shops and late chief enspector of the Bird-Archer Company; George W. Worth, who for twenty-five years was boiler inspector for the city of New York; Geo. W. Laughton, a well-known engineer and recently a salesman with the Crandall Packing Company, and W. B. Pierce, a marine engineer. The Boston, Baltimore, Norfolk, Philadelphia and Havana offices are all stated to be in the hands of experienced men. The new company has secured as advertising manager A. Eugene Michel, mechanical engineer and a late publicity manager. Mr. Michel is thoroughly familiar with the technical and practical side of engineering, so that the reader of the new company's advertising is assured of wholesome information which bears investigation and will prove of practical value.

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

NEW ZEALAND NEWSPAPERS, just arrived, tell that the motor boat event at the annual Ponsonsby regatta at Auckland, witnessed by 10,000 persons, was won by *L'Aiglon,* powered with an American-made engine—a 6-horsepower heavy-duty Buffalo. It seems that this Ponsonsby regatta is the big thing over there, and it looks as if the population of the entire country must have turned out to see it.

AN ANNOUNCEMENT.—"The Griscom-Spencer Company will hereafter devote its attention and manufacturing facilities to the production and promotion of its marine and other engineering specialties, steamship repairs and general engineering work. Having turned over to Mr. M. K. Bowman its miscellaneous supply business, as conducted for so many years at 229-230 West street, New York, where it will be hereafter carried on by Mr. Bowman and his associates under the title of the M. K. Bowman-Edson Company, we bespeak for Mr. Bowman and his company the favorable consideration of the trade, and assure our clients that our best wishes go with Mr. Bowman in his new enterprise.—The Griscom-Spencer Company."

ANOTHER ANNOUNCEMENT.—"The M. K. Bowman-Edson Company has taken over the miscellaneous supply business, as conducted for so many years by the James Reilly Repair & Supply Company and the Griscom-Spencer Company, of which companies Mr. M. K. Bowman has for seventeen years been the treasurer. The company is located in the warehouse at 229-230 West street (the old stand). Mr. Bowman is president and active manager, and solicits from his friends and trade acquaintances made during his thirty-five years' association with the supply business their favorable consideration."

M. E. B. A. CONVENTION.—The rooms of the Bird-Archer Company, manufacturer of boiler compound, were made the headquarters by the delegates when not in session. The rooms were designated by a large electric sign showing the trademark of the firm. The company was represented by Richard Kelly, marine manager; Thomas Service and C. T. McGern, who furnished each delegate with two beautiful souvenirs—a seal leather pocketbook and a pair of gold sleeve buttons, upon which were enameled the insignia of the M. E. B. A. Besides these, a handsome calendar was given. Refreshments were served in their rooms, which were kept open night and day. The Garlock Packing Company was well represented at the convention, and a 5-foot steel tape was presented to each delegate with the compliments of the above company. The Peerless Rubber Manufacturing Company was represented by Stephen Roberts, Herbert Self, Charles Heitzmann and J. L. Lounsberry, who entertained their friends in a suite of rooms. Greene, Tweed & Company were represented by Frank Ransley and B. M. Bulkley. Green, Hook & Company were represented by Stanley K. Green, president, together with Mr. Chapman, their New York representative, and Mr. Fechter, their Baltimore representative. Manning, Maxwell & Moore and the Consolidated Valve Company were represented by L. M. Brigham and Frank P. Corbett.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
First Vice-President—Charles S. Follett, 477 Arcade Annex, Seattle, Wash.
Second Vice-President—E. I. Jenkins, 3707 Clinton Ave., Cleveland, O.
Third Vice-President—Charles N. Vosburgh, 6323 Patton St., New Orleans, La.
Secretary—Albert L. Jones, 289 Champlain St., Detroit, Mich.
Treasurer—John Henry, 315 South Sixth St., Saginaw, Mich.

ADVISORY BOARD.

Chairman—Wm. Sheffer, 428 N. Carey St., Baltimore, Md.
Secretary—W. D. Blaicher, 10 Exchange St., Buffalo, N. Y.
Franklin J. Houghton, Port Richmond, L. I., N. Y.

BUSINESS NOTES

GREAT BRITAIN

TEMPOMETER OR HOROMETRICAL CHART.—"This ingenious invention is designed in a clear and simple manner, and consists of a clock dial, beautifully printed in colors and mounted on a stout card, in the center of which is a revolving disc. By means of this revolving disc the local mean time, latitude and longitude of all the principal cities, towns and other landmarks throughout the world can be seen at a glance. In conjunction therewith, a calendar is arranged whereby the years, months, weeks and days since the introduction of the new method of time into Britain (1752 A. D.) and onwards, are in full view of the user as in an ordinary calendar. Useful decorative features are obtained by showing (centrally) diagram of the earth's orbit, and, consequently, the process of the seasons, while four corner panels are symbolical of morning, noon, evening and night. The tempometer, being printed in colors, is artistic and attractive, and should be in every ship, office, school and home, as it will be found to be an absolute requisite and a welcome desideratum. For educational purposes alone every school and home should possess this chart. Full instructions with each chart, and can be had from all booksellers, stationers and chartsellers throughout the world, or direct from James Munro & Company, Ltd., 101-103 King street, Tradeston, Glasgow."

TRADE PUBLICATIONS.

AMERICA

"The J. M. Packing Expert" is published by H. W. Johns-Manville Company, 100 William street, New York, and any one of our readers who will mention this magazine will be put on the free mailing list upon application. The object of the publication is to keep the engineering public in touch with developments in the packing business.

A jet condenser, giving a vacuum of 28.75 inches of mercury, which is so designed that a thorough mixture of exhaust steam and cooling water takes place, and at the same time the air present is prevented from pocketing and is delivered to the air pump at a minimum temperature, involves numerous interesting departures in condenser design. These features are brought out and the general theory of jet condenser construction discussed in a reprint of the article, "A Radical Improvement in Jet Condensers." This booklet is being distributed by the Wheeler Condenser & Engineering Company, of Carteret, N. J.

The Bridgeport Motor Company, Bridgeport, Conn., has just issued its 1910 catalogue. "No radical changes have been made in the Bridgeport for 1910; no weak points in its construction have presented themselves, and, in our opinion, backed by the report of our customers at large, the Bridgeport motor to-day represents the highest stage of marine gasoline motor perfection. The descriptive matter on the pages following has been compiled in as simple a manner as possible, that the most inexperienced in mechanical subjects may understand and appreciate the quality of our product. We do not countenance the employment of misleading statements, nor do we enlarge upon the description of unimportant features, with a view of influencing prospective purchasers who do not know. Our policy is to build Bridgeport motors first-class in every detail—to provide our customers with substantial, practical motors, that are simple, easy to operate, easy to care for, economical in fuel consumption—and most important of all—economical in repairs."

"Illustrated Opinions" is the title of a 156-page book published by the Roberts Safety Water Tube Boiler Company, Red Bank, N. J. "The Roberts Safety Watertube Boiler was invented, for use in his own yacht, by Mr. E. E. Roberts, of New York. He had been for many years an engineer in the regular service of the United States navy, and had had a large experience with the machinery of merchant vessels. At the time of the invention of the boiler he was doing business as a consulting engineer in New York, and was very successful in that line. He had lately purchased a summer cottage on the banks of the Shrewsbury River in New Jersey, anu the salt in his blood made it necessary that he should have some sort of craft with which to enjoy the beautiful Shrewsbury River and its connections. Doing business in New York and living in New Jersey, left such a short time each day for the enjoyment of the water that it was absolutely necessary for him to have a boiler which would get up steam with great rapidity upon arrival at home. He had tried all the boilers generally used without satisfaction, when the idea of a steady waterline, quick-steaming, watertube boiler suggested itself to him, and he built one which proved entirely satisfactory. This boiler is still in use in the launch *Mamie C.* This boiler was, however, a very crude affair compared with the boiler subsequently patented by Mr. Roberts. The boiler was not originally invented for commercial purposes. The inventor had a very satisfactory business at the time, and did not care to make any change in that respect. After using the *Mamie C.* for about two years he sold her to Mr. A. E. Clark, and we believe she is still owned by that gentleman. She acted as the first advertisement for the boiler, and the result was that inquiries and orders began to pour in upon Mr Roberts to such an extent that he was obliged to give up his business as consulting engineer and eventually organize the Roberts Safety Water Tube Boiler Company. Over 1,600 boilers were sold previous to the time that this pamphlet went to press in the spring of 1908. They range in power from 10 horsepower to 700 horsepower each. They are used for all types of vessels, and, to a greater or less extent, by all the departments of the United States Government, as well as by a number of foreign governments. The boilers are of light weight, occupy little space, are practically non-explosive, are easily repaired without recourse to the boiler shop, and furnish absolutely dry steam. The water in the gage-glass is probably more steady than in that of any other boiler in existence. They meet all the requirements of the United States Inspection Service, and are licensed for 250 pounds of steam—and frequently for much in excess of that pressure."

A very complete catalogue of 564 pages has been issued by the Lunkenheimer Company, Cincinnati, Ohio, and a copy will be sent free to any of our readers who will mention this magazine. This catalogue must have at least a thousand illustrations, and no one in the market for such specialties as brass and iron valves, whistles, cocks, gages, injectors, oil pumps, oil and grease cups, etc., should fail to send for a copy.

Marine auxiliary specialties of many kinds are described in illustrated circulars published by the William Powell Company, Cincinnati, Ohio. Among these are the "Union" composite disc valve, an improved glass cylinder oil pump, injectors, a multiple-sight feed oiler, the "Cyclone" blow-off valve, compression grease cups, the "Trojan" lubricator, throttle valves of various types, engine oilers, the Powell "White Star" valve, grease cups and many others.

Fox motors form the subject of a pamphlet published by the Dean Manufacturing Company, Newport, Ky. The special feature of this company's motor is stated to be the design and location of an auxiliary fourth port. Through this port air is drawn into the expansion chamber slightly in advance of the incoming charge of gas, and it is stated that this injection of air accomplishes the double purpose of expelling the burned gas without waste of fuel, and leaving pure air in the explosion chamber instead of vitiated gas.

A pamphlet entitled *Arrangement of Engine Cylinders to Produce Uniform Torque,* has just been issued by the American Engine Company, Bound Brook, N. J. This pamphlet contains typical indicator cards taken from the American ball-angle compound engine, and also a derived crank effort diagram. This diagram shows that this type of engine produces a torque which is nearly as uniform as that given by steam turbines, while the steam consumption is considerably less than that of turbines. The booklet also contains a discussion of the crank effort diagram, and will be sent free upon application.

"Rainbow" packing is the subject of a folder published by the Peerless Rubber Manufacturing Company, 16 Warren street, New York City. This packing is suitable for any kind of steam, air or hot-water joint. It is non-conducting, and the claim is made that it is especially durable, effective and economical. The joints can be made and broken in one-eighth of the time consumed with the packings that harden, as a tool is not required to break or face-off the joint. This packing is said to make a tight joint, no matter how rough the surface may be to which it is applied, and not to be affected by oil, ammonia, steam, heat or alkalies, nor will it harden or crack.

A handsome gas-engine catalogue has just been issued by the Buffalo Gasolene Motor Company, 1209 to 1221 Niagara street, Buffalo, N. Y. "Buffalo" engines have been installed in some of the best-known working boats, tugs, launches, yachts and motor boats in the country, and the company makes a specialty of fitting a boat with exactly the kind of engine suitable for its use. There are twenty-two different kinds of "Buffalo" engines and three distinct types. The regular type ranges from 2 to 100 horsepower in two to six cylinders. The heavy-duty type from 4 to 54 horsepower in one to six cylinders. In the lightweight high-speed type there are four sizes, the latest being a high-power eight-cylinder concentrated racing machine of the improved V-type.

In a pamphlet entitled *Advertising and Its Service,* the Geo. H. Gibson Company, Tribune building, New York, has reprinted from the New York *Evening Post* an article discussing the economic theory of advertising, especially as regards the engineering and mechanical industries. It is shown that, contrary to current academic opinion, properly directed advertising reduces the cost of distribution of goods by providing the salesmen with a greater number of selling opportunities in a given territory and in a given time. It performs the preliminary but necessary work of informing and educating the prospective user as to the nature, possibilities and profitableness of improved machinery, thereby hastening its adoption. Greater sales, brought about through advertising, usually make possible cheaper production, thereby benefiting the community as a whole, while competitive advertising, which seems to be the especial bugaboo of socialistic writers, is also a benefit, insomuch as it stimulates to improvements in the design of apparatus, and advertising is necessary in order that such improvements may meet with a prompt and adequate reward. A secondary benefit is derived from the fact that a consistent policy of advertising lessens the capital risk when new enterprises are undertaken and insures permanency to a business. In other words, advertising does not become an added burden on the consumer. Copies of this pamphlet may be had from the Geo. H. Gibson Company.

Dixon's "Eterno," an indelible pencil, is described by the Joseph Dixon Crucible Company, Jersey City, N. J., in a pamphlet just issued. This pencil writes black and copies purple, and will be found valuable for office use.

Cast iron exhaust fans and the "Dixie" exhaust fan are the subject of Bulletins Nos. 271 and 272 published by the American Blower Company, Detroit, Mich. The "Dixie" fan is especially suitable for removing shavings, iron filings, emery dust, etc.

The Blaisdell air compressors, made in all types and sizes, and for every purpose to which compressed air is applied, are the subject of bulletin No. 15 issued by the Blaisdell Machinery Company, Bradford, Pa. Detailed specifications covering any particular size will be furnished by the company upon application.

The Syracuse chemical fire extinguisher, which is said to be especially desirable for marine use, is described in a booklet published by the Syracuse Chemical Fire Extinguisher Company, Syracuse, N. Y. The claim is made that this extinguisher is the only non-freezing acid and soda extinguisher on the market.

"Some Samples of Gears Correctly Cut" are illustrated in a booklet published by the Fawcus Machine Company, 2820 Smallman street, Pittsburg, Pa. This company makes gears and pinions of all kinds, besides double-axle cutting off and centering machines, and complete operating mechanism for all kinds of lifting, rolling and swinging bridges.

A sample corrugated copper gasket for steam, water, air or acid is being distributed by the United States Mineral Wool Company, 140 Cedar street, New York City. The claim is made that connections with these gaskets will not blow out after continued use, and that they are especially useful on pipes in which steam is alternately off and on.

"Centrifugal Pumps" is the title of a catalogue published by the Lawrence Pump & Engine Company, Lawrence, Mass. Among the pumps this company makes is a sand and dredging pump, with a 7 by 8 engine, which may be driven by a belt, or directly coupled to the engine. The company also makes circulating pumps suitable for marine use.

Valves of many kinds form the subject of a 36-page catalogue distributed by the Caskey Valve Company, Holmesburg, Philadelphia, Pa. Among the various valves described in this catalogue are blow-off valves, steam valves, hydraulic stop valves, hydraulic single-operating valves, hydraulic two-pressure valves, hydraulic four-way valves and air valves.

Packings for all purposes, manufactured by the Home Rubber Company, Trenton, N. J., are described in a handsomely printed and illustrated catalogue of 122 pages which the company has just issued. A free copy of this catalogue, as well as a useful fountain pencil, will be sent upon request to any of our readers mentioning INTERNATIONAL MARINE ENGINEERING.

TRADE PUBLICATIONS

GREAT BRITAIN

A catalogue of drop-stamps and other machinery for die-forging work has been issued by B. & S. Massey, Openshaw, Manchester. Drop-stamps with steam lifters on the Brett system are illustrated. Massey's patent friction lift is also described, and stamps with tups weighing from 3 to 20 cwt. are shown fitted with this form of lift. The catalogue also gives particulars of board drop-stamps, steam stamping hammers, trimming presses, bar-heating furnaces for coke or oil fuel, and illustrates a number of sample forgings to show the class of work that can be dealt with by drop-stamps of different weights.

Marine auxiliary machinery is described and illustrated in a 72-page catalogue issued by G. & J. Weir, Ltd., Cathcart, Glasgow. The company states that the issue of the new edition of its sectional catalogue has been found necessary on account of modifications, additions and improvements made in the specialties the firm manufactures for merchant marine service. The attention of G. & J. Weir, Ltd., has been devoted for many years to methods and appliances for the prevention of corrosion in boilers, feed heating, boiler feeding and similar questions connected with marine boilers. Among the auxiliaries described and illustrated in this catalogue are feed-water heaters of various types, feed pumps, hydrokineters, air pumps and others. A special catalogue has been issued by the company describing its patent evaporator, which has been adopted by many of the leading steamship companies throughout the world.

Lathes of various types and other machine tools are described in illustrated sheets issued by John Lang & Sons, Johnstone. Sheet 205 states that from the experience gained by the use of modern high-speed steel, John Lang & Sons have decided to place on the market a range of lathes fitted with duplex, double-geared step-cone headstocks. These headstocks are said to possess a number of excellent features not embodied in the ordinary double-geared type.

George Swift & Sons, Claremont Iron Works, Halifax, have issued two catalogue sections of machine tools, and also a list of tools in stock. The first gives drilling machines of the radial, wall, pillar and bench types, double and treble-geared sliding, surfacing and screw-cutting lathes, from 12½ to 24½-inch centers, and also slotting machines, single-ended punching and shearing machines, and some other tools. In the other part high-speed radial drilling and tapping machines, multiple and pillar drilling machines, and planing and shaping machines are illustrated, together with screw-cutting lathes ranging from 4 to 12½-inch centers. The catalogues contain specifications and give full particulars of all the tools.

Toope's Asbestos Covering Company, Ltd., Stepney Square, Stepney, E., have issued a catalogue of asbestos, felt and plastic non-conducting coverings. The list illustrates and describes the firm's patent removable pipe coverings, such as asbestos, hair-felt, silicate cotton, etc., combined in different ways. The "Coronation" air-space coverings are an important specialty of Messrs. Toope, suitable for steam pipes, boilers, etc., corrugated paper is combined with felt, asbestos fiber and other materials; covers composed entirely of corrugated asbestos millboard are also illustrated. Two other coverings, having dead air spaces, are illustrated, the space being obtained in one of these by supporting the covering away from the pipe on rings of the same material as the outer covering. In the other case, plastic material is plastered on to a wire netting, which is supported away from the pipe.

A patent protective lubricating box for propeller shafts, manufactured by F. R. Cedervall & Söner, Gothenburg, Sweden, has been officially approved by Lloyd's, Bureau Veritas and the Norwegian Veritas, and has been applied to numerous steamers classed in their books. Among a few of the advantages claimed for this invention are that it increases the number of revolutions of engines, enables the tail-end shaft to be efficiently lubricated by oil; that it prevents sea water and grit from entering the stern tube; that costly brass liners on shaft and lignum vitæ bearings are dispensed with; that galvanic action is practically eliminated, and that it provides maximum protection against breakdown to propeller shafts. Old stern-tube arrangements can be altered for application of the lubricating box at comparatively small cost.

Messrs. James Munro & Company, Ltd., 101 and 103 King street, Tradeston, Glasgow, have favored us with a copy of their Tempometer or Horometrical Chart which they recently issued. The chart is substantially a dial, well printed in colors and mounted on a stout card, in the center is a revolving disc. The disc indicates the local mean time, latitude and longitude of all the principal cities and towns. A very ingenious calendar is also contained as the chart, by which the years, months, weeks and days since the introduction of the new method of time into Britain (1752 A. D.) and onwards, are displayed as in an ordinary calendar. The tempometer, which is artistically and attractively got up, should prove of very great use in the offices of all shipowners as well as on board ships. The chart can be obtained from Messrs. Munro & Company at 2s. 6d. on stout card, or 5s. framed in polished oak or other rich wood.

Centrifugal pumps are described in a catalogue published by Balcke & Company, Ltd., 27 Clement's Lane, London, E. C. This firm makes pumps of all sizes from the very smallest to the very largest, both horizontal and vertical, for low lifts and for very high lifts. The catalogue is well printed and illustrated, and contains concise information regarding the company's productions.

A high-speed disc sawing machine is described in an illustrated circular issued by Clifton & Baird, Empress Works, Johnstone, near Glasgow. The firm's 42-inch machine, horizontal type, is esecipally designed for rapidly sawing cold channel and joist sections up to 20 by 7½ inches, also rails, angles, etc. The statement is made that a heavy channel section of 12 by 6 by ¾-inch metal can be sawed through in about fifteen seconds.

The "Sentinel" steam trap, for pressures up to 250 pounds, is described in circulars issued by Alley & MacLellan, Ltd., Sentinel Works, Glasgow. It is stated that this steam trap has certain special features, in that it automatically regrinds its valve after each discharge; that it shuts off absolutely and does not dribble; that it preserves its tightness with gritty steam and under high pressure, and that it has a renewable valve and seat of pure nickel.

W. N. Brunton & Son, Wire Mills, Musselburgh, N. B., have published a small list giving particulars of the various kinds of their steel wire and rods. The list includes cast steel drill rods, or silver steel rods, suitable for twist-drills, taps, punches and other small tools. Prices are given for rods from 0.013 to 1¼ inches in diameter; they can be supplied up to 2½ inches in diameter; rods of similar sizes are also supplied in the "Flying Scotsman" brand of high-speed steel.

"Disc Grinding, its Economy and Advantages," is the title of a circular distributed by Perkin & Company, Ltd., Lord Street Engineering Works, Leeds. The circular states that there is an immense amount of work for which the ordinary emery machine is of no use, and that such work is generally finished by milling or shaping, followed by draw-filing or scraping to a surface plate, with heavy expenditure of time and labor, and that this work can almost invariably be done more perfectly and in a fraction of the time by means of a disc grinding machine, which is practically a rotary file traveling at the rate of 2 miles a minute.

BUSINESS NOTES

AMERICA

JOHN D. MCRAE, Oswego, N. Y., announces that Morison & Fox corrugated furnaces can now be furnished for marine and stationary purposes, and are guaranteed to meet all Government requirements. Mr. McRae solicits inquiries, and hopes to be favored with prints and specifications.

THE WATSON-STILLMAN COMPANY, 50 Church street, New York, has made several additions to its sales department to handle increasing business in hydraulic tools and turbine pumps. Mr. Edwin Stillman has entered the sales department, and is assisting in taking care of customers in New York State, while all Southern railroad business is now in charge of Mr. Frank C. Clark. The more direct representation that has become necessary in the Orient will be in the hands of Mr. F. W. Horn, the well-known machinery importer of Yokahama, Japan.

A WOOD PRESERVATIVE FOR MARINE USE.—The Carbolineum Wood Preserving Company, 349 West Broadway, New York, states that "Carbolineum" prevents damage from teredos, or ship worms, and that particulars regarding many tests will be given by letter upon application. The tests in question were made privately and without the company's knowledge by an official of unquestioned standing. The company will also be pleased to tell about chemical as well as practical tests made by government officials in United States navy yards, and to refer inquiries to those under whose charge such tests were made. Carbolineum is stated to be valuable for use on the hulls of vessels as well as on the roofs of deck houses, around the hatches, and on the bottom of all boats, particularly fishing boats; for when these grate over a shoal or reef it is stated that Carbolineum will not rub off like copper paint, as it sinks deeply into the wood fiber. It will not scale or peel off but stays, and it prevents fungus growth, barnacles or other pests. The catalogue published by the Carbolineum Company contains many testimonials from well-known steamship owners as to the efficacy of this material, among them being the North German Lloyd, the United States Lighthouse Service, the Mallory Steamship Company, the Oregon Railroad & Navigation Company and many others.

WE ARE INFORMED that owing to the increased cost of cotton and rubber, manufacturers of fire hose will be obliged to advance their price of hose at least 10 cents per foot.

THE EUREKA FIRE HOSE MANUFACTURING COMPANY, 13 Barclay street, New York, has opened an office at 610 Postal Telegraph building, San Francisco, Cal., with Mr. W. A. Daggett as manager.

ADAM COOK'S SONS, 313 West street, New York City, manufacturers of Albany Grease, report that their business in the year 1909 was especially satisfactory, and that the outlook for 1910 is most promising.

HORACE F. THAYER, JR., 1025 Market street, Wilmington, Del., in addition to his work as a naval architect, has taken the agency of some well-known concerns manufacturing gasoline engines, metallic packings, motor boats, launches and row-boats, propellers and reversing gears.

THE EUREKA FIRE HOSE MANUFACTURING COMPANY, 13 Barclay street, New York, has made a change in its Western territory, and the States of North Dakota, Montana and Wyoming are now under the management of W. S. Nott Company, Minneapolis, Minn.

THE BERGESEN MANUFACTURING COMPANY, 74 Broadway, New York, writes us that it has found a new field for steering engines, as it has several orders for steering engines for inland river steamers. The company states that its success in that direction is due to the simplicity, durability and low price of its machines.

L. W. FERDINAND & COMPANY, 201 South street, Boston, Mass., state that they have recently supplied linoleum cement for the United States Custom House, Central High School and Soldan High School, of St. Louis, also for the Denver Auditorium at Denver, and for a battleship under construction in Philadelphia.

THE STRELINGER MARINE ENGINE COMPANY, Detroit, Mich., has purchased the business of the United Manufacturing Company, which made the "Little Giant" marine engine. The Strelinger Company will continue to manufacture this engine in sizes from 1½ to 16 horsepower, in addition to the former Strelinger line of four-cycle motors, from 4 to 60 horsepower.

THE LARGEST MARINE CASTINGS.—We are informed that some of the steel castings which will be used in the construction of the new White Star steamships *Olympic* and *Titanic* are the largest and heaviest ever made. The total weight of the stern frame, rudder and brackets in each of these steamships will be approximately 289 tons, made up as follows: Stern frame, 70 tons; after boss arms, 74 tons; forward boss arms, 45 tons, and rudder, 100 tons.

BUSINESS NOTES

GREAT BRITAIN

WE HAD THE OPPORTUNITY recently of going over the new supplies department of Siemens Bros. Dynamo Works, which the firm opened this week at 39 Upper Thames street. At this address a stock will be kept in future of articles required by contractors, such as wire, cables and cable accessories, installation accessories, incandescent and "Tantalum" lamps and fittings, arc lamps and carbons, small motors and accessories, meters, dry and wet cells. The Thames street house supersedes the departments which have hitherto been conducted at 6 Bath street and 1 Abchurch Yard, E. C. The new premises comprise six spacious floors and basement. The ground floor is arranged for counter trade, and every facility is provided for executing customers' orders with the utmost promptness. The first floor is devoted to an extensive showroom, where companies' specialties will be exhibited. One feature will be a tasteful display of the latest designs in artistic electric light fittings and shades, exhibited in conjunction with the well-known "Tantalum" lamps, which have of late years taken such an important place in the electric lighting industry. There are no less than 160 points to enable a demonstration of all types of shades and lamps. The third floor is occupied by the manufactures of Siemens Bros. & Company, Ltd., and a comprehensive stock of all sizes of wires and cables is carried. The remaining floors contain a comprehensive stock of all articles required by the trade. Stannos wiring is used throughout the building, and it is left open so that this important system can be clearly seen. The Siemens firms are in the unique position of being able to manufacture at their extensive works in Great Britain goods ranging from a small incandescent lamp to motors of 16,000 horsepower, and from the smallest bell wire to Atlantic cable.

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

AILSA CRAIG MOTOR FOR TECHNICAL COLLEGE.—One of the most interesting orders recently received by the Ailsa Craig Motor Company, Strand-on-the-Green, Chiswick, W., is from the authorities of the new technical college at Port Arthur, Manchuria. The engine selected is a four-cylinder Ailsa Craig marine motor of 18 horsepower, using petrol or paraffin fuel. It is to be fitted with double ignition, consisting of Bosch low-tension magneto, with magnetic make-and-break plugs, and also with a Thomson-Bennett high-tension dis-terminals and cases.

A 36-INCH HIGH-SPEED DISC SAWING MACHINE for cutting malleable iron tubes up to 6 inches diameter outside, is made by Clifton & Waddell, Johnstone, near Glasgow. The output is 2,000 to 3,000 tubes per day. "This machine consists of strong, massive frame of box section, having two self-lubricating journals fitted with patent anti-friction white metal adjustable bearings. The front and back journals are 3½ inches diameter by 12 inches long. Spindle is of high-tensile steel, 3½ inches diameter, with shoulder and over-hung portion 5 inches diameter, having disc saw 36 inches diameter, fitted with mild steel flanges 20 inches diameter on either side and lock nut on end. On opposite end lock nuts with washer for taking up wear. Mild steel pulley 8 inches diameter by 9 inches broad keyed to spindle. Material and workmanship guaranteed first-class throughout. Weight, 40 cwts. Price, £105, packed and delivered f. o. b., Glasgow or Leith. Delivery five weeks."

BULL'S METAL PROPELLERS.—Bull's Metal & Melloid Company, Ltd., of Yoker, near Glasgow, is the pioneer in the introduction of bronze propellers and solid propellers for large vessels of great power. It is stated that the advantages of bronze propellers, chief of which are greater lightness, smoothness of surface, resistance to corrosion, thinner and, therefore, more efficient sections, promote a saving of fuel of from 10 to 15 percent over that required when either cast iron or steel propellers are used. The introduction of solid propellers for large vessels was strenuously opposed, but over ten years' experience has proved not only that solid propellers are less subject to serious damage by accident than built-up propellers, but also that substantial improvements in speed and reductions in fuel consumption are possible when loose-bladed cast iron or steel propellers are replaced by solid bronze propellers. It is stated that in one instance where a loose-bladed bronze propeller, weighing about 16 tons, was replaced by a solid Bull's metal propeller, weighing 11½ tons, the improvement in speed was fully three-quarters of a knot. The Bull's metal used in these propellers is very tough, which protects them from serious damage by collisions, groundings, etc. If damaged, however, they can easily be straightened and repaired. It is stated that fully 80 percent of the tonnage ordered during the last twelve months from British yards for British owners will be fitted with bronze propellers, and in many cases where iron is fitted this is only done provisionally to ascertain the best form of propeller to be subsequently cast and supplied in bronze.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
First Vice-President—Art Hyde, 9115 Willard Ave., N. W., Cleveland, Ohio.
Second Vice-President—Wm. P. Tindall, 180 Twentieth St., Detroit, Mich.
Third Vice-President—Charles N. Vosburgh, 6323 Patton St., New Orleans, La.
Secretary—Geo. A. Grubb, 1040 Dakin St., Chicago, Ill.
Treasurer—A. L. Jones, 38 Avery Ave., Detroit, Mich.

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Secretary—Wm. L. Bridges, 784½ Twelfth St., Milwaukee, Wis.
John A. Watts, 318 Fifth St., S. E., Washington, D. C.

AMONG THE ADVANTAGES of C. C. metallic mirrors for searchlights, which are made by the Reflector Syndicate, Ltd., 82 Victoria street, Westminster, London, S. W., are that they are not fractured by concussion and that even when they are penetrated by bullets the area of distortion is very small; that the light reflected from these mirrors is more penetrating in fog and at night; that the combination mirrors of gold and silver bands retain the dazzling effect required for military purposes; that the object on which the light is thrown stands out in greater relief; that the intensity of light is so great that it is impossible to aim accurately at the projector; that these mirrors are lighter than glass mirrors and more durable, besides reflecting a larger quantity of light.

SUPERHEATERS FOR OCEAN STEAMERS.—The steamer *Answald,* built by the Bremer Vulcan, at Vegesack, for the Hamburg-Bremen Africa Line, is the first German ocean boat to be fitted with a steam superheater. The *Answald,* a boat of 7,800 tons, started on her first trip to Delagoa Bay on Dec. 18 last. The dimensions of the ship are: Length, 127.4 meters (about 418 feet); breadth, 16.5 meters (54¼ feet); draft, 7.8 meters (25½ feet), and the speed is to be 11 or 12 knots. The Schmidt boilers have a heating surface of 675 square meters (7,266 square feet), and generate steam of 370 degrees C. at 13.5 atmospheres (698 degrees F. at 192 pounds per square inch). The engines were designed to develop from 2,650 to 3,200 horsepower. During the trial runs the engines indicated 3,650 horsepower, and the speed attained was 13.5 knots. The Howden draft system is being used, and the engines are fitted with Lentz valve gear.

TRADE PUBLICATIONS.

AMERICA

A high-pressure pilot reducing valve, which is said to be especially adapted for marine use, is manufactured by Kieley & Mueller, 34 West Thirteenth street, New York City. This valve is of the single-seat type, in consequence of which difference in the expansion of the metals of which it is constructed does not prevent it from closing absolutely tight. The construction of the internal parts is such that every portion can be renewed. A free copy of the company's catalogue will be sent to any of our readers upon request.

"Graphite on Shipboard."—A little book of twenty-four pages under the above title has just been got out by the Joseph Dixon Crucible Company, Jersey City, N. J. As the name indicates, it deals with the use of graphite about the ship, and points out the advantages that graphite offers as a lubricant for various parts of machinery. The booklet specifically deals with the lubrication of marine engines, thrust and stern bearings. The information is especially valuable because of its definiteness, the booklet describing exactly how graphite is applied for the purposes mentioned. One of the commanders in the United States navy said, with reference to the use of graphite in marine service: "One of the first orders I gave on joining this ship was forbidding the use of oil in any of the steam cylinders, and to enforce this order I had all the oil cups removed from the steam pipes leading to the cylinders, so that it was impossible for the men to use oil. When these cylinders were examined, at intervals of from three to six months, I simply had them wiped out with a little waste and saturated with vaseline and Dixon's graphite; and I must say that I have never seen the cylinders and piston rings in better condition than they were on this ship during my three years of duty." All those who are interested in the subject of lubrication on boats, large or small, should write to the Dixon Company, at Jersey City, for a free copy of the booklet named.

Ice Machines for Marine Use.—H. B. Roelker, 41 Maiden Lane, New York, has published circulars describing the Allen dense air machine, which he states is the only ice machine which has with satisfaction and safety been placed in the main engine room of a steamer, and is attended by the regular engineers along with their work, while the meat room is in a distant convenient portion of the vessel. Thus it avoids the nuisance of carrying a specialist, who generally manages to escape the control of the chief engineer. This machine contains only common air at reasonable pressure and only machinery similar to usual steam engine machinery. There are no auxiliary pumps or other machinery carried outside of the ice room. Mr. Roelker states that the smaller machines placed in the steam yachts *Electra*, *Atlanta*, *Nourmahal* and the United States *Boston* and *Chicago*, have worked well for many years without giving any trouble to their attendants, while the large machines placed in the United States & Brazilian Mail Steamship Company's *Seguranca* and *Vigilancia* gave perfect satisfaction in that service, as do those with which the four Pacific Mail Steamship Company's steamers were fitted out, the *Costa Rica*, *Nicaragua*, *Columbia* and *Peru* in the China and South American service. About 300 of these machines are in daily service on steam vessels in the tropics, and most of these have been so employed for years.

A marine ice machine is described in an illustrated catalogue issued by the Reynolds Ice Machine Company, 135 Broadway, New York. This is an air machine, and the catalogue states: "Broadly speaking, there are two distinct types of ice machine on the market—one using a chemical while the other uses no chemical of any kind but only free air. Chemical machines are very economical in producing ice and refrigeration under certain conditions, but they are open to the serious objection that they require a chemical, which is not always obtainable. As the chemical generally is ammonia or carbonic gas, danger is encountered in the use of either. If ammonia escapes through leakage or accident, it is not only very offensive but may prove dangerous to life. While carbonic acid gas is not offensive it is very dangerous, for, as it is a heavy gas, it sinks, and as it is unodorous a person can be suffocated by it without any warning whatever. With the chemical ice machine many accidents have occurred, in a number of cases resulting in death. Either chemical machine will produce large quantities of ice more economically than the air machine; the air machine, however, has the very great advantage in operation that it requires nothing but free air, which is always obtainable, and which, if it escapes, does no injury. The air machine, therefore, is perfectly safe; hence, well adapted to use in ships, hotels, apartment houses, hospitals, etc."

The bucket catalogue published by the Brown Hoisting Machinery Company, Cleveland, Ohio, is a handsomely illustrated booklet of 54 pages. One of the interesting half-tone pictures shows a view of Havana harbor, including the 60-cubic foot Brownhoist coal-grab bucket used on four Brownhoist barge tramways belonging to the Havana Coal Company.

Dart unions and flanges are described in circulars published by the E. M. Dart Manufacturing Company, Providence, R. I. The claim is made that the two bronze seats prevent corrosion, and that the malleable iron pipe ends and nut insure strength and durability; that these two points are essential to make perfect and lasting joints. Samples will be sent to responsible parties.

The various uses of vanadium are described in pamphlet form by the American Vanadium Company, Frick building, Pittsburg, Pa., in both French and German, under the titles of *Vanadium Stahl* and *Les Aciers au Vanadium*. Free copies of either of the pamphlets may be obtained upon application to the American Vanadium Company, Frick building, Pittsburg, Pa. The American Vanadium Company states that not long ago vanadium was a rare element, but that in the past five years it has been accepted as a "master alloy" for the production of high-grade steel, as it is said to surpass all other elements in its power of imparting high elastic limits and higher tensile strengths. "Vanadium carries away oxides and nitrides in a fusible slag, leaving a dense, non-porous, homogeneous metal, that will not crystallize under severe impacts, shocks and vibration. The increased strength permits the use of smaller members in machine parts; gives a higher factor of safety and greater durability wherever applied. For shafts, gears, piston rods, engine forgings, chains—for all parts that meet high duty and rigorous service—for the vital parts, vanadium steels have no competitor. Booklets with tests, analyses, types for various uses, and directions for application and heat treatment on request."

Injectors are the subject of Catalogue No. 24 published by the Penberthy Injector Company, 342 Holden avenue, Detroit, Mich. This catalogue states: "The Penberthy Automatic Injector has been too long upon the market and is too well-known to the steam user and the steam supply trade to need any introduction or explanation. The auto-positive injector has now been on the market for several years, and has won deserved recognition for its reliability under extreme conditions, while retaining the utmost simplicity of construction. By a peculiar arrangement of the over-flow valves it will work on higher pressures and handle hotter water than the Penberthy automatic. In comparing the two styles the question will often arise in the mind of the user, 'Which type of injector will give the best results?' In answering this question, not only must the comparative results obtained from the two styles be borne in mind, but also the fact that no injector will give as economical or satisfactory results when working near its highest limit; and, further, as the parts begin to wear its working range is decreased. We therefore recommend for pressures at 140 pounds and upwards, or where the temperature of the water supply is above 110 at 100 pounds pressure or over, that the auto-positive injector be given the preference. For all other conditions, and particularly for traction engine use, we recommend the Penberthy automatic."

A marine register and indicator is the subject of a booklet issued by the McNab Indicator Company, Bridgeport, Conn. "The McNab register and indicator gives to the captain the knowledge the engineer possesses and to the engineer the knowledge which the captain possesses. In other words, it practically puts one man in two places at the same time, and this spells life and safety for all on board in time of need. No matter in what part of the ship these two men may temporarily be, a glance at this convenient indicator shows each 'how she is running.' Isn't it worth while? And should sudden danger confront the ship while one or both of these men are off duty, instantly, each knows what is happening by a glance at the indicator. There can be several of them scattered over the ship. One can be installed in the pilot house or bridge. One of the instruments can be placed in the captain's room. One of the instruments can be placed in the chief engineer's room, and anywhere on the vessel where advantageous. The instruments will at all times keep the captain and officers in touch with every movement of the main propelling engines, whether it is slow, half or full speed, astern or ahead, as the instrument moves in unison with the main engines. The instrument in the captain's room notifies him if the vessel is running at the required speed. Should the captain hear the clock-like tick of the instrument slow down, stop and see the indicator go astern, he instantly knows that his vessel is in danger; he could be on the bridge at once and probably save disaster in mid-ocean."

Blocks are described and illustrated in a catalogue just issued by the Pittsburg Block & Manufacturing Company, 818 South avenue, Allegheny, Pa. The company makes a specialty of blocks for use on board ship.

Row locks of every description are illustrated in a pamphlet published by the New York Boat Oar Company, 69 West street, New York. Special designs are made by this company for every purpose.

Packings for every purpose are the subject of a handsome catalogue published by the Clement Restein Company, Philadelphia, Pa. This is a volume of 160 pages, fully illustrated and printed in two colors. Several new styles and combinations not shown in the last catalogue are included in the latest and a free copy will be sent to any reader mentioning this magazine.

Metallic packings are described in an illustrated circular distributed by the S. M. Hildreth Company, 2 Rector street, New York City. The makers state that these packings hold any pressure of steam, gas or air and any degree of vacuum. The rings are ordinarily made of cast iron, but a high-grade bronze or babbitt metal is used when conditions require. Special packings, fitted with the Morris patent breaker rings, are made for internal combustion engines, and self-adjusting rotary packings for Corliss valve stems. Trial orders will be sent upon approval.

In Catalogue "K," which has just been issued by the Lagonda Manufacturing Company, Springfield, Ohio, the construction and use of the new "quick repair head" is fully discussed. It points out the advantage of always having sharp cutter wheels on a boiler cleaner, and shows by diagrams how easily the cutters can be renewed. The complete line of air, steam and water-turbine boiler cleaners built by this company is also illustrated and described, and a brief description is included of a new cleaner for firetube boilers which they have just brought out. Copies of this catalogue may be had by addressing the above company.

Wire rope is the subject of an illustrated catalogue issued by the Durable Wire Rope Company, 93 Pearl street, Boston, Mass. "Experience has established the fact that Durable Wire Rope, under almost all conditions, is superior to any other rope in the market, either wire or manila, for hoisting, stevedoring, elevators, ships' rigging, towing hawsers, mooring ropes, drilling, hauling, dredging, etc. To those who are contemplating the installation of new ropes for any purpose, full detailed information, with recommendations, will be given on application to the head office of the Durable Wire Rope Company, 93 Pearl street, Boston, Mass., or to any of its various sales agencies. Full particulars as to the conditions under which the rope will be used, including maximum loads, size of sheaves, style of grooves, size and kind of rope previously used, etc., should accompany every inquiry."

Steam Turbine Bulletins.—The Kerr Turbine Company, Wellsville, N. Y., has just issued two new bulletins, No. 9, *Turbo-Blower Units* and No. 10, *Steam Turbine Generators, Steam Turbine Centrifugal Pumps.* The first bulletin illustrates practical outfits for forced and induced draft, gas works service and for furnishing blast for cupolas. The other bulletin includes generating sets for electric power and lighting, and pumping units for boiler feeding, fire service, water supply, circulating condenser water, draining sumps, and for other service where water must be delivered at moderate or high pressure or against considerable head. Both of these bulletins contain interesting descriptive matter about the construction and operation of Kerr steam turbines. The comparisons between turbine and reciprocating engines can profitably be read by all who are in charge of or operate steam power plants. Both bulletins will be mailed upon request.

Dredges are described in a handsomely illustrated catalogue published by the Bellefontaine Foundry & Machine Company, Bellefontaine, Ohio. This company's machines are stated to have many new ideas not found in other makes, which make them easy of operation, quick in action and producers of results at a minimum cost of operation. The dippers are built entirely of structural material, designed for filling to the fullest capacity and quickly shedding the dirt when tripped. Two styles are built, one for rigid-handle connection and the other for adjustable-handle connection. The operating levers are said to be well worthy of notice. The throttle, hoisting, backing and swaying are all operated by two levers. The swinging engines are standard steam reverse, compound gear, double cylinder, and vary in size from 6 by 6 to 8 by 10. The hulls are so constructed that the width can be changed with very little loss of lumber, as the longitudinal construction is the same regardless of the width.

TRADE PUBLICATIONS
GREAT BRITAIN

Any persons interested in the transmission of power should write to Harpers, Ltd., Aberdeen, mentioning INTERNATIONAL MARINE ENGINEERING, and ask for a copy of the company's new Catalogue 12, which contains information of considerable value to owners, managers, engineers, buyers or exporters, who in any way use power transmission.

The "Sentinel" winch condenser, made by Alley & MacLellan, Ltd., Sentinel Works, Polmadie, Glasgow, is the subject of a catalogue that company has issued. "It is now becoming general practice among shipowners, superintending and consulting engineers to fit their steamers with auxiliary condensers, as they are usually termed, winch condensers, into which all the winches and auxiliary engines can exhaust. The old system, which still prevails to a great extent, of allowing all the exhaust steam from the winches, etc., to escape into the atmosphere, or into a tank and then to the atmosphere, is found to be a most wasteful method of working. By the use of a winch condenser, properly fitted, all the exhaust steam from winches, etc., is condensed, and the condensed water can be pumped, at a temperature of about 160 degrees F., into the donkey boiler or other boiler in use. There is thus by this method a considerable saving of fuel, by reason of the feed water being heated about 100 degrees F. above the temperature of the sea or river water. The feed water, being fresh, prevents the loss of fuel involved while feeding the boiler with sea water, in having to keep the water in the boiler at a safe working density, by blowing out hot water and making up the loss with cold water. There is a further important gain, due to the hot fresh feed water. The efficiency of the boiler is increased considerably, steam is more easily maintained, and the gain is practically equal to an increase in size of the boiler."

Evaporators are the subject of Catalogue No. 3 published by G. & J. Weir, Ltd., Cathcart, Glasgow. "The efficiency of an evaporator largely depends on the amount and nature of the heating surface, and the method by which the tube coils in this evaporator are made uniformly efficient is a feature worthy of attention. In general, steam passed into apparatus of the kind has air associated with it, and if currents are not continuously maintained through all the tubes, the air accumulates and lodges in any tube in which there is little or no current, and renders such tube practically inefficient as a heat exchanging medium. The steam becomes reduced in volume as it passes along the tubes; and as the tubes are ordinarily of equal area at both ends, the discharge of water of condensation, or a mixture of such water, vapor and air is necessarily comparatively slow. And it happens in practice that in certain circumstances little or no discharge takes place through some of a set of tubes, while steam may blow quite freely through others, which leads to air being accumulated in the tubes through which there is little or no current. In the Weir vertical type evaporator this difficulty is overcome by making the outlet opening or orifice from the tubes of smaller diameter than the inlet, with the exception of that in the lowest tube, which is the same area throughout and by which any steam passing through the smaller outlets from the tubes is again returned through the evaporator along with the water of condensation and drained to the hot-well. By this means the pressure in the standpipe chamber at the outlet end is always lower than in the chamber at the inlet end, and a constant current is kept up through all the tubes, thus preventing any accumulation of air or water."

Messrs. Holzapfels, Ltd., Milburn House, Newcastle-on-Tyne, have published a heavy list of vessels coated with Holzapfels' compositions during the first half of the current year. The list gives the names and owners of over 3,000 vessels of upwards of 7,011,897 tons gross register.

A patent beveling machine, which is said to be especially adapted for use in shipyards, is described in circulars published by Davis & Primrose, Etna Iron Works, Leith. The No. 1 size is suitable for angle-bars up to 7 inches by 5 inches by 9/16 inch thick.

Pneumatic tools are the subject of an illustrated catalogue published by the Consolidated Pneumatic Tool Company, Ltd., Palace Chambers, 9 Bridge street, Westminster, London, S. W. Among the numerous tools illustrated are drills of many types for all purposes, grinders, tube cutters and expanders, reamers, etc.

BUSINESS NOTES

AMERICA

MIAMI, FLA.—"W. F. Harris, the millionaire motorboatist of Palm Beach and New York, is making ambitious and thorough plans to capture first honors in the chief American and Canadian racing events of the coming season. He aspires to be one of the victorious defenders of the British International Trophy against the British challengers. Mr. Harris has procured the latest production of the Buffalo line of marine engines, one of the new 225 horsepower, eight-cylinder 'en V' type Buffalo speed engines, for a new 40-foot raceboat, being built for him by the Gilbert Motor Boat Company of Brockville, Ont. Mr. Harris is at present the owner of the champion racing boat of Canada. Besides this he owns two other speed boats, a day cruiser and a deep-sea-cruising yacht. Surely, Mr. Harris has at least a tendency toward motor boating. With his new forty-footer, powered with the 225 horsepower 'en V' Buffalo, Mr. Harris has signified his intention of entering the Thousand Islands' Gold Cup races, the Canadian championships, the elimination trials for the British International Cup, the Hudson River races, the M. V. P. B. A. regatta at Peoria, the Inter-Lake Association races, and as many other speed contests as he can possibly cover with one boat in one season."

HEMP ROPE is used exclusively in the manufacture of the oakum made by W. O. Davey & Sons, 170 Laidlaw avenue, Jersey City, N. J. The claim is made that it spins a thread of greater length, that it drives better, that it is more economical, and that it lasts longer than any other oakum on market.

A GREAT INCREASE IN BUSINESS.—The American Steam Gauge & Manufacturing Company, 208 Camden street, Boston, Mass., announces that its business for January, 1910, not alone greatly exceeded any previous January, but proved to be the largest month's business ever done during the sixty years the company has been engaged in manufacturing power plant appliances. It is also stated that this business consisted entirely in normal orders from every section of the continent.

THE NEW ENGINE made by the B. F. Sturtevant Company, Hyde Park, Mass., is described by the manufacturer as follows: "This engine is the result of over 50 years' experience in engine building, and for work requiring an absolutely dependable, quiet running engine for either automatic or throttling regulation there is no better engine built. The reciprocating parts are entirely enclosed within the oil and dust proof frame, yet are readily accessible for adjustment. Lubrication system is of the gravity type, automatic and positive. The oil flows from the reservoir in the top of the frame through piping equipped with sight feeds to all bearings. All oil not used flows to the reservoir in the base, is filtered through fine screens, and pumped back into the reservoir in the top of the frame. The engine may be run independently of the oil pump by filling the top reservoir through an opening provided in the frame and drawing off the excess oil from the bottom reservoir through a drain cock. The cylinder is separated from the frame by a distance piece in which are the water-shed partition and main piston rod stuffing boxes. These are readily accessible while the engine is in operation. Regulation of the automatic type is most accurate. The variation between no-load and full-load is not over one and one-half per cent. Steam consumption is economical. Operation may be continuous at high speeds for long periods with very little attention. Accurate balance insures freedom from vibration. Material and workmanship are the very best obtainable. Each part is subject to rigid inspection before being assembled, and the completed engine is given a rigid test and careful examination before shipping."

ATTENTION IS CALLED to the want advertisement of *Mechanical Engineer* on page 13 of this issue.

WALTER B. SNOW, publicity engineer, 170 Summer street, Boston, Mass., has more than doubled his facilities by moving to rooms 421 to 425 in the same building, and has added to his staff Mr. Benjamin Baker, and Mr. Herbert M. Wilcox.

THE TUBULAR INSIDE MICROMETER GAGE, made by the Brown & Sharpe Manufacturing Company, Providence, R. I., is a new tool for accurate measurement of the bores of marine engines, cross-slides, etc. It is adjusted to make the finest measurements accurately. Each gauge has a range of one inch, and there are 37 sizes, from 3 to 40 inches.

TESTING CENTRIFUGAL PUMPS.—The De Laval Steam Turbine Company, Trenton, N. J., suggests that all purchasers of centrifugal pumps insist upon a test to see that they are getting the efficiency promised. The company states that every purchaser of a De Laval centrifugal pump is invited to send a representative to the company's testing floor to be present at the test of the pump he has ordered, and that if a pump does not exactly meet every condition of the specifications, it need not to be accepted.

WELIN DAVITS ON THE NEW WHITE STAR LINERS.—It is announced that the new White Star liners *Olympic* and *Titanic*, which are to be by far the largest ships in the world, outclassing in size even the *Lusitania* and *Mauretania*, are each to be equipped with sixteen sets of Welin quadrant boat davits, manufactured by the Welin Davit and Lane & De-Groot Company, Cons., 17 Battery Place, New York City. This company, among various large orders received from all over the world, has also recently equipped some of the new Japanese merchant ships with this device.

CHAIN BLOCKS.—The Yale & Towne Manufacturing Company, 9 Murray street, New York City, states that "in 1876 we built the first differential chain block; were the exclusive manufacturers under the Weston patents. We think it fair to say that the whole history of the problem of hoisting has been written in our shops—thirty-six years of unceasing search for improvement. The triplex block to-day—the best hand hoist made—has cut-steel gears; bronze bushings; drop-forged pinions and shaft; independent gear cover; welded hand chains. Every part standardized, interchangeable. The whole dirt-proof, durable, efficient."

DUE TO FAST INCREASING BUSINESS, both the Chicago and Baltimore branches of the H. W. Johns-Manville Company have outgrown their present quarters, and have been moved to new locations, with more room. The Chicago branch, now on Randolph street, has moved to the four-story and basement building at Nos. 27-29 Michigan avenue, located in the block between South Water and River streets. With 32,500 square feet of floor space, offices, store and stock rooms will all be under one roof, with ample room for all. A full stock of J-M products will be carried, thus assuring prompt shipments. The Baltimore office, store and warehouse is now located at No. 30 Light street. Here the company will have considerably more room than before, and will keep on hand a large stock of J-M products, and will be in much better position than ever to give all orders prompt attention.

THE MARINE BOILER COMPOUNDS, made by Green, Hook & Company, Inc., 30 Church street, New York, are described by the manufacturer as follows: Mercuri-film offers vital protection in two equally effective ways. First: It contains elements (based upon our analysis of your feed water or scale) which attack the old scale and scale-forming particles in the water to reduce them to a non-adhesive sludge that passes out the blow-off. Second: It forms upon the inner boiler surfaces a thin, metallic amalgam coating, which repels scale-forming particles and is, at the same time, impervious to corrosive acids. With Mercuri-film you buy the service of most competent chemists in making a careful selection of especially prepared ingredients. You get a low price because of our extensive manufacturing facilities, and you get better service, better boiler protection and better fuel economy per dollar invested than obtainable with other boiler water treatment. These are not careless statements, but based upon scientific proofs from actual practical demonstrations. We stand ready to prove that Mercuri-film treatment stops scale and corrosion troubles without hindering ebullition or interfering with heat transmission. Try Mercuri-film in one boiler and be convinced. If you are not, ask us for your money, and you will get it back. If Mercuri-film fails the expense of the trial is ours and we lose. If it succeeds, you win. We know it will succeed. Tell us your scale or corrosion troubles and send samples of scale or feed water, so that we may quote price."

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

For Sale.—Volumes 6 to 16, inclusive, of *Transactions of Society of Naval Architects.* In good condition. Address *Box 21,* care International Marine Engineering.

Mechanical Engineer, 35 years old, with long practical experience in the construction and design of machinery and handling men, desires active position with growing concern doing marine repair work and installing machinery. Prepared to make a moderate investment. Highest references furnished. Address *Mechanical Engineer,* care International Marine Engineering.

Inventor of patent telemotor wishes to communicate with firm who would take up manufacture. British and American patents. Address *Telemotor,* care International Marine Engineering.

Wanted.—A limited number of competent ship and hull engineering draftsmen. Apply by letter, stating age, experience and salary required, to the *Chief Hull Draftsman,* Fore River Shipbuilding Company, Quincy, Mass., U. S. A.

Wanted.—One copy each of International Marine Engineering for February and March, 1907. Address *Engineer,* care International Marine Engineering, 17 Battery Place, New York.

BUSINESS NOTES

GREAT BRITAIN

Miller & Company, Ltd., London Road Foundry, Edinburgh, write International Marine Engineering that their fire bars "Are made in chilled moulds—not moulded in sand. The surface towards the fire is specially armor-hardened—practically the same effect is obtained as with armor plating on a war vessel, the hardening being almost identical in both cases. The makers claim double life for them under ordinary heat. After two years' trial on the *Hibernia,* the Allan Line has placed them in the *Hungarian, Arcadian* and *Ionian.* They are also being adopted by the General Steam Navigation Company."

J. Lang & Sons, Johnstone, who are now prepared to machine-cut spur wheels up to 15 feet diameter and 6 inches circular pitch, have recently built for this department a quadruple-geared surfacing and boring lathe for turning wheel planks up to 10 feet diameter. It is fitted with the firm's variable-speed headstock, with automatic speed-changing mechanism for facing, etc. The bed is 15 feet 3 inches long, by 5 feet wide, and has a narrow guide for the saddle in the centre, and two T-slotted guides, 10½ inches wide at the sides. The fast headstock weighs with chuck, etc., over 11 tons. The main spindle, of special crucible steel, is 12 inches diameter at the front journal, which runs in a heavy phosphor-bronze bearing 14 inches long. Bolted to a large flange is a four-jaw faceplate chuck 6 feet diameter, with an internal spur-driving wheel behind. The variable-speed cones are 36 inches diameter, and the bevel-edged reduction is 18 to 1, giving spindle speeds of 6 to 45 revolutions; and the quadruple reduction is 144 to 1, giving spindle speeds of ¾ to 6 revolutions, with the constant-speed driving shaft making 300 revolutions a minute. Fast and loose pulleys, 24 inches diameter by 8 inches wide, are fixed on the driving shaft, and may be belted direct to the line shafting. Connection between the automatic variable-speed spindle and the feed-box shaft is made by an inclined shaft with worm gear at the top and mitre wheels enclosed in a spherical casing at the foot, as illustrated. The saddle can be moved along the bed by means of a large screw and ratchet lever, and fixed by bolts engaging the slots in the bed. On the saddle are carried two slide rests, each 24 inches wide, with narrow square guides at the front, fitted with top slides 16 inches wide and 4 feet 6 inches long. Both slides may be clamped at any desired angle to sector scales. One of the slides may be used for facing a rim while the other is turning the external diameter, and both slides have self-acting feeds in all directions, including angular. Both for surfacing and boring the feeds are ½ inch, ¼ inch, ⅛ inch, and 1/16 inch per revolution. The extension plate bedded on the floor is for carrying a pillar rest, to be used only on work with a diameter near the full capacity. Finally, the machine is capable of taking cuts requiring a 40 b.h.p. drive, occupies a floor space of about 16 feet by 8 feet, and weighs approximately 23 tons.

F. R. Cedervall & Söner, Gothenburg, Sweden, manufacturers of an improved protective and lubricating box for propeller shafts, state: "The boxes for protecting and lubricating tail-end shafts hitherto in use, although quite answering their purpose, are much encumbered with the inconvenience of necessitating a certain fixed distance between the propellerboss and the end of the sterntube bush, so as to get the exact compression on the spiral springs, which is most essential for the proper working of the box under every circumstances. Is it sometimes very difficult, however, to attain this exact distance. This is especially the case when shifting propellers, where it often happens that the new propeller goes farther up or not so far up on the shaft as the old one. In cases of wear in the trust bearings or on the working surfaces of the sterntube bush and the box the compression also will differ from the standard. In such cases it is a rather time-wasting and expensive matter to get the box readjusted. It has, therefore, aften been expressed, both by engine builders and shipowners, the advisability of a box that could be adjusted according to the existing space between the propeller and the sterntube bush. In view of these reasons the patent 'adjustable box' has been invented. It is so constructed that it can be lengthened or shortened as required within practical limits and yet retain the proper compression on the spiral springs."

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

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TRADE PUBLICATIONS.

AMERICA

"Hydraulic Valves and Fittings" is the title of a 120-page illustrated catalogue just issued by the Watson-Stillman Company, 188 Fulton street, New York. Its pages list more types and combinations of hydraulic valves and fittings than ever before described in any catalogue. Almost every page contains some hint or advice as to the best piping arrangements, what types or combinations of valves are best suited to certain work, how the valve arrangement may operate a number of cylinders or machines automatically, etc. Any engineer will find this book handy when figuring on new hydraulic installations or making changes on old ones. This book will be sent free to any one requesting Catalogue No. 78.

Open feed-water heaters are described in Bulletin BK-843, published by the Blake & Knowles Steam Pump Works, 115 Broadway, New York. "Advantages of an open heater: In an open heater the water is heated by direct contact with the exhaust steam. The heating capacity is always at its maximum, and there can be no falling off in the temperature at which the feed water leaves the heater, due to any collection of mud or scale. All impurities in the feed water, such as sand, mud, floating particles, etc., are caught and retained in the filter. Carbonates of lime and magnesia which precipitate when water is heated to a temperature close to the boiling point, are deposited in the heater and do not reach the boiler. Water contains air and carbonic acid gas in solution. In the process of heating these are liberated. If the separation takes place in the heater no damage results, but if allowed to pass through the feed piping, and to the boiler, the liberated gases attack the wrought iron and steel, and rapid oxidization follows. The convenience and advantages of a storage tank or hot well for holding a considerable amount of water which may be drawn upon as desired, for boiler feeding and other purposes, as well as a reservoir for receiving live steam drips and returns from heating or drying systems, are apparent. By the addition of a simple float controlled valve, the water required for supplementing the other sources of supply is controlled automatically, and the amount admitted is regulated exactly to make up for the drafts made on the storage supply. Ordinarily, if oil gets into the feed water it passes on to the boilers, where it is harmful, and in sufficient quantities, dangerous. Hence one of the most important of the several functions performed by the heater is to remove all the oil from the incoming exhaust steam."

Centrifugal pumping machinery, marine and stationary engines are described in a 96-page illustrated catalogue published by the Morris Machine Works, Baldwinsville, N. Y. Among the illustrations in this catalogue are those of right and left-hand 15-inch dredging pumps with 200-horsepower compound engines. "The merits of the hydraulic suction dredge are well recognized, and in comparison with other systems of dredging it has been proven to be the most economical for handling sand, gravel, mud, clay, etc., or in fact any material except solid rock. The steam shovel, dipper or elevator dredge will do efficient service in raising material, but none are capable of delivering the material except within a short radius of the dredging operation. If the material is to be delivered to any distance it must be done by means of scows, tugs or other means outside of the dredge. The centrifugal dredge not only raises the material but also delivers it at just the point wanted at one operation and with only one machine, which, as regards cost, is less expensive, size for size, than any of the others. Besides, it is practically impossible to build any other type with the enormous capacity which some hydraulic dredges have. On page 52 we illustrate a complete dredge equipped with 20-inch dredging pump and with cutter machinery for cutting up the material. In this dredge the pump is directly connected to a 600-horsepower triple-expansion engine, and the dredge is capable of delivering through a pipe line 5,000 feet in length. The hydraulic dredge consists mainly of a centrifugal dredging pump with power to drive same, and auxiliary machinery for handling suction pipe and boat. The pump in operation creates a strong suction flow in the suction pipe sufficient to pick up the material and draw it into the pump, from which it is again delivered through the discharge pipe any distance to point of delivery, and can at the same time be elevated to reasonable heights. Sand, mud, silt, etc., are readily picked up by the suction force only. If the material is hard packed, it must first be cut up by a special revolving cutter or sometimes by a jet system. For ordinary service where no agitating device is necessary to cut up the material, the dredge becomes very simple, consisting mainly of a scow with engine and boiler, a mast and boom only being required for handling suction pipe.

The Nicholson ship log is described in a pamphlet issued by the manufacturer, the Nicholson Ship Log Company, Cleveland, Ohio. This log is stated in the catalogue to be a radical departure from all other types of nautical measuring devices. In addition to giving the mileage sailed it shows the speed per hour on a dial and records this speed on a chart at every minute of the trip. Among the advantages claimed are accuracy, and the fact that it is entirely automatic, requiring very little attention besides the daily winding of the clock and changing the paper record. Unless the harbor is very shallow no thought need be given to the log when making or leaving port. If the vessel is operated in shallow places, provision is made while installing to draw in the in-take tube from the pilot-house, or the sea cocks can be placed high enough on the bilge to prevent the fouling of the tube. The registering apparatus is placed where it may be readily seen and read. The catalogue also states that in some instances a log has paid for itself many times over in preventing damage suits for alleged excessive speeds in dangerous passages.

Graphoil lubricating specialties are the subject of a pamphlet issued by the Graphoil Lubricator Sales Company, 90 West street, New York City. Graphite is combined with oil "in proper proportions, and uniformly fed without the use of any moving parts" in the Graphoil lubricator, which is designed to be used in connection with any oiling system, and which, it is stated, may be installed without putting the present equipment out of commission. Graphoil specialties comprise complete graphite and oil lubricators and graphite cups for lubricating the cylinders of marine, locomotive and stationary steam engines, gas engines, air and ammonia pumps, vacuum pumps, and also for bearings, crank pins, eccentrics, etc. It is claimed that the use of these lubricators reduces oil consumption 50 to 75 percent, increases the effective horsepower, reducing oil in the boiler feed, reduces the wear and tear of the engine and boiler, protects and prolongs the life of packing, insures lubrication should the oil supply be temporarily interrupted, insures effective lubrication under high pressures and prevents hot bearings.

Weinland tube cleaners, made by the Lagonda Manufacturing Company, Springfield, Ohio, are the subject of an illustrated catalogue this company has just issued. "One of the greatest problems that the engineer has had since the earliest days of the boiler is to find some method to successfully combat the formation of scale. The large majority of boiler users are compelled to use the water at hand, and the only way to keep the boiler in good working condition is by frequent cleaning by means of mechanical cleaners. The selection of a particular type of cleaner for any given work depends upon the size and shape of the boiler tubes, nature and thickness of scale, allowable duration of shut-down, rapidity with which scale accumulates, and the number of boilers. We make all types of cleaners, and do not recommend any one machine until one of our experts has investigated your particular case. Where scale is of moderate thickness cur turbine cleaner, on account of its convenience, proves most acceptable. Turbine cleaners will, we believe, always be in demand. As we have had twenty years' experience in dealing with boiler troubles, and have made and developed numerous styles of cleaners, we consider that the apparatus which we now put on the market represents the best practice. The Wineland turbine cleaners combine mechanical skill and good material, and are backed by twenty years' experience and study on the subject. That these are excellent tools is proven by their long use and many imitators. In the various types described in the following pages we have made several new departures, all of which represent a growth and improvement on machines that have already proved their value. We frequently find plants where, through neglect or ignorance of the attendants, or severe conditions, boiler tubes have become so encrusted that it is almost impossible to clean them with a turbine cleaner. In such cases we recommend our mechanical cleaners, or our air and steam motor-driven cleaners, as a large saving in time will result from their use. We often find it advisable to rent these machines at so much per boiler or per tube, and after the first cleaning has been effected, subsequent cleanings can easily be handled by a turbine cleaner, or if the customer prefers we will clean boilers by contract, such service being performed by our force of experts, who undertake the work on short notice, and as they are thoroughly familiar with their subject can carry the work to completion in the shortest possible time and in a most satisfactory manner. We invite your correspondence, and would be glad to have you consult with any of our offices distributed throughout the leading cities of the United States. When we know your particular troubles and the conditions under which you operate, we can tell you exactly what type of cleaner is best adapted for your needs."

That fiber packng is kept soft, and that friction is eliminated where metallic packing is used, is guaranteed by the Peerless Oiler & Woper Company, 100 William street, New York City. This oiler and wiper is said to oil the rod with every stroke and to save 90 percent of your oil where drip cups are used and swabbing done. The device is stated by the maker to be inexpensive, easily attached to the gland studs and to last indefinitely.

Orange peel grab buckets are the subject of a catalogue published by the Mead-Morrison Manufacturing Company, 149 Broadway, New York. These grabs are bronze bushed throughout, and the blades have renewable manganese steel points. It is claimed that they are superior in design, workmanship and material and are durable and efficient.

Regarding the American-Thompson Indicator.—The American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass., has had reprinted, and is distributing, a folder containing a number of unsolicited testimonials from engineers regarding these indicators. Following is a fair sample of these testimonial letters: "We wish to advise that we have received the advertisement which you mailed us a couple of days ago, and in connection with same we might state that we purchased an American-Thompson indicator about eight years ago. This has been in continuous service ever since, and we are perfectly satisfied with same. We wish to ask if you could conveniently mail us at this time one of your indicator books mentioned in your advertisement."

The attention of marine engineers is called by the William Powell Company, Cincinnati, Ohio, to its White Star and Union disc valves. "Our White Star valve has a white metal composition disc, in the smaller sizes, $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{4}$. These discs are swiveling. In the $\frac{3}{4}$ and larger they not only swivel but they are also reversible, having two faces; all are regrinding. With an occasional regrinding these valves will last as long as the pipes. When the discs are worn out you only have to buy a new disc. Can also furnish this valve with inserted seat ring made of the same white metal bronze. This ring can be replaced when necessary, thus continuing the body in use indefinitely. Or, if you prefer a vulcanized composition washer disc valve, then we offer our Union disc. It is built on exactly the same lines as the White Star; that is, the construction is similar, with the one exception of the disc and the face of the seat; in the former the seat is beveled, whereas the Union disc has a flat-faced seat to accommodate the style of washer."

"Thor" air tools are described in profusely illustrated circulars published by the Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago. Among the tools described are a piston air drill, with a capacity for drilling up to $2\frac{1}{2}$ inches diameter and reaming up to 2 inches in diameter, a reversible compound slow-speed piston air drill designed for extra heavy drilling, reaming, tapping, rolling large flues and putting in flexible stay-bolts; a one-piece riveting hammer, which will drive rivets up to $1\frac{1}{4}$ inches in diameter (there is no coupling between the barrel and the handle); the No. 40 hammer, the weight of which is 13 pounds, said to be especially useful for light riveting, tank work, etc.; the No. 3 chipping and calking hammer equipped with duplex valves. There is also an illustration of this company's "Thor" stay-bolt driver in operation on a locomotive fire-box, and the statement is made that it can drive at the rate of 100 ends, or fifty bolts, per hour. Pneumatic hose, hose couplers, wood-boring machines, etc., are also described in these circulars.

Fuel economizers and air heaters are described and illustrated in Catalogue 150 just issued by the B. F. Sturtevant Company, Hyde Park, Mass. "The principle of the Sturtevant economizer is to conduct the hot waste gases which have passed through the boilers and are escaping into the chimney around and between a system of cast iron pipes containing feed water, thus heating a large volume of feed water to a high temperature before it enters the boilers, accomplishing all this saving in fuel and gaining this extra boiler capacity by the use of otherwise wasted gases. The Sturtevant economizer saves 10 to 20 percent in fuel by supplying the boiler with water almost to the boiling point, thus saving the coal necessary to heat cold feed water. It increases the boiler capacity 20 to 40 percent, as the large reserve of hot feed water, always ready in the economizer, leaves the boilers only the work of bringing the hot water to the vaporizing point. This enables the boiler to convert much more water into steam when aided by an economizer. By heating the feed water the boiler gets none of the sudden expansion and contraction due to the change of temperature when cold water is fed, thus avoiding many leaks and prolonging the life of the boiler. The purifying of the water by lessening the scale increases the durability of the boilers as a whole by reducing the tendency to bag. The feed water is purified by heating in the economizer, and in circulating through the economizer pipes a large part of the impurities settle in a section which is easily cleaned out. This gives purer water to the boiler, reducing the amount of scale and allowing the boilers to steam much more freely. It reduces the amount of soot in the chimney and lessens smoke from the stack, as the hot gases in passing through the economizer deposit a large amount of soot on the economizer pipes. This soot is automatically scraped from these pipes and deposited in a soot chamber under the economizer."

TRADE PUBLICATIONS
GREAT BRITAIN

Trier Bros., Caxton House, Westminster, S. W., have published a catalogue of their products, which include Stauffer's lubricant and "Tell-Tale" and other lubricators suitable for use with this lubricant. Trier's patent grindstone dressers are illustrated, also an excellent tool for truing emery and carborundum wheels. The "Split-Grip" set-collar for shafting, etc., is also described. The special features of this collar are that it has no projecting parts, and, being made in halves, is very easily placed in position on, or removed from, the shaft.

The Yorkshire Boiler.—We have received from the Yorkshire Boiler Company, Ltd., Registered Offices, Standard buildings, City Square, Leeds, a pamphlet describing the Yorkshire boiler designed by Mr. W. H. Casmey. This boiler is a modification of the Lancashire, but it is shorter in proportion to its diameter, the ratio of length to diameter being as 5 to 2. The flues rise slightly from front to back, and expand from the end of the furnaces to the down-take in the proportion of 5 to 6. The sectional area of the flues at the rear is thus about 33 percent greater than at the front, and the effect is that more water is located directly over the points where the larger proportion of heat is transmitted to the boiler than at any other point. Comparative tests, quoted, which indicate that four boilers of this kind, 24 feet by 9 feet, can evaporate as much water as five 30-foot by 9-foot Lancashire boilers. Orders have recently been received by the company for six boilers 24 feet by 9 feet, three 24 feet by 8 feet 6 inches, one 20 feet by 7 feet for China, and one 20 feet by 8 feet 6 inches for the Glasgow Corporation.

Gold dredges, river steamers, etc., are the subject of an illustrated catalogue published by Arthur R. Brown, 54 New Broad street, London. "It is a well-known fact that gold dredgers should be specially designed to suit the particular requirements of the place in which they have to work. We always impress this fact on intending buyers who write to us for price lists of dredgers, and in reply to such inquiries find it necessary to write long explanatory letters on gold dredging, asking for various information as regards the property in question before we care to quote, as the design and consequently the price of a suitable gold dredger is governed by a number of conditions, apart from its actual capacity, or the quantity of material it can treat per hour; such, for instance, as the dredging depth which regulates the length of ladder and size of pontoon: the nature of the ground to be treated, on which depends the area of gold-saving tables, kind of tables, and whether a screen or sluice-box is required, and the design of the same; the design of the gearing (different gear being required for hard or soft ground); and the size and design of pumping plant to wash the material. If the dredger is required to work banks, it is necessary to have full information as to height of banks above water level, on which depends the question of the height of the tailings elevator or whether it is required or not. The depth of water in the river if the dredger is to be floated to its destination also regulates the size of the pontoon, and the part of the world where the dredger has to work, and the climate also affects the design; also, of course, the motive power for driving the machinery: if fuel is required, the nature of the same; also the question of means of transport from port of embarkation to the place where the dredger has to be re-erected regulates the size of pieces in which it can be delivered and the quantity of work which can be done here before shipment."

Some circulars dealing with the advantages of their blue Cape asbestos mattresses, felt and rope for covering boilers, steam pipes, etc., have been issued by the Cape Asbestos Company, Ltd., 23 King street, E. C. Illustrations of large power plants, in which Cape coverings have been installed, are included.

The Maschinenfabrik Augsburg-Nurnberg A.-G., the well-known Continental firm, whose London address is M. A. N., 219 Caxton House, Westminster, S. W., have published pamphlets describing the "M. A. N." Diesel oil engines. One of these pamphlets contains particulars of standard engines with one, two, three or four cylinders, ranging from 8 to 880 brake-horsepower. Another deals with enclosed high-speed engines of 50 to 1,000 horsepower, with two, three or four cylinders. The company state that over 155,000 brake-horsepower are in use and under construction for land and marine purposes in all sizes, from 8 brake-horsepower upwards.

For the patent rotary exhauster, made by the Baker Blower Engineering Company, Stanley street, Sheffield, the following advantages are claimed in a circular published by the manufacturer: First, it is simple and not liable to get out of order, having no sliding vanes or pistons working under pressure internally, and therefore subject to wear and tear. Second, it passes a great volume at a low speed, and is consequently low in price. Third, all the working parts requiring attention and lubrication are external, and can always be inspected and attended to from the outside. Fourth, the internal arrangements can be seen by removing the top cover without disturbing the inlet and outlet connections on the exhauster. Fifth, the internal parts not moving in absolute contact, but so close as to be practically tight, the wear and tear is confined to the journals and gear, where ample surfaces are provided, and all of which can be adjusted from the outside, so that the smallest amount of power is required for the work performed. Sixth, ample provision is made for drawing off the tar, and its deposition on the inside of the machine cannot in any way injuriously affect its working or efficiency. Seventh, all shafts are large in diameter and have adjustable stuffing-boxes, whilst the revolving drums are carefully balanced and capable of adjustment from the outside. All material and workmanship are of the best quality. The gear is carefully protected, every precaution and appliance being used to make these machines thoroughly reliable, durable and effective.

The Portland Forge Company, Ltd., Kilmarnock, N. B., have issued a very excellent pamphlet, which illustrates and describes the "Portland" patented self-centering rudder bearings and the "Portland" patented balanced rudders.

Pulley blocks and traveling cranes are described and illustrated in book 62 issued by Herbert Morris & Bastert, Ltd., Empress Works, Loughborough, Leicestershire. "The *raison d'être* of a pulley block is the easy handling of heavy loads. It is essential that it should give the user plenty of power so that an average man may be able to handle easily any load within its capacity, for small nd medium sizes, nd two or three men for the very heaviest sizes. Look to your dead charges. It affects the labor bill.

The Adnil Electric Company, Ltd., Adnil building, Artillery lane, E. C., have published a catalogue dealing with their telephone and signaling apparatus. The telephones include magneto and battery wall and desk sets; loud-speaking telephones for use in situations where bell signals cannot be heard; gas and water-tight telephones; intercommunication instruments and accessories. The catalogue contains particulars of electric hooters and bells, signaling instruments; distant indicating thermometers; water gages and other apparatus of a like nature. "Alpha" self-winding electric clocks are also shown. These clocks can be used as timepieces or in connection with any of the signaling devices.

Grinding machinery is the subject of a catalogue published by the Vincit Company, Ltd., 67 Aldersgate street, London, E. C. "Carborundum and electrite are by far the hardest materials known, standing next in this respect to the diamond. The cutting edges of carborundum and electrite grains are sharper than those of any other abrasive. The importance of these advantages will not only be manifest to those who are aware that emery, corundum and similar natural minerals have been altogether superseding by the products of the electric furnace, but also to those who are acquainted with the fact that there are various qualities even among artificial abrasives, and who wish to have the best. We are the exclusive manufacturers of carborundum (Acheson's process) in Europe, and the only makers of electrite in the world. We thus possess the unique advantage of being the makers of two distinct modern grinding materials, each unequaled in its suitability of purpose and of unrivaled excellence."

"Sentinel Junior" engines are described by Alley & MacLellan, Ltd., Sentinel Works, Polmadie, Glasgow, in a catalogue the company has issued. Among the good points claimed for these engines, which are stated to be suitable for dynamos and generators, centrifugal pumps, boiler draft, etc., are simplicity, solidity, durability, accessibility, steam economy, efficient lubrication, etc.

A price list and catalogue of marine and stationary motors has been issued by the Parsons Motor Company, Ltd., Town Quay, Southampton. This catalogue calls especial attention to the fact that the Parsons Motor Company is this year making separate engines for petrol and paraffin, owing to the demand for engines to use a commoner paraffin, and for this purpose the company has adopted its new vaporizer instead of relying upon the valve surface as heretofore.

Vickers Sons & Maxim, Ltd., 32 Victoria street, S. W., have issued a circular dealing with the V. S. M. "Turret" lock-nut. We have already illustrated their special lock-nut (December, 1909, page 504). A projecting collar or turret in these nuts is pierced by six or more holes. Two slots are cut in the bolt, and when the nut is tightened up a split-pin is passed through a pair of holes in the collar and one of these slots. The circular gives prices of bolts and nuts from ¼ inch to 1 inch in diameter.

"Mechanical Ventilation Specialties" is the title of the latest catalogue issued by Jno. Gibbs & Son, 72-76 Duke street, Liverpool. A large number of illustrations and particulars of fans for air propelling and ventilating, driven by belts, motors and steam engines and ships' ventilators of the weather-proof downcast type. Messrs. Gibbs & Son make a specialty of a motor-driven fan, the motor of which is encased to prevent the entrance of dust and water, and the fans have their blades secured by means of a double boss locked with flanges in such a manner as to grip them and prevent their flying out.

Escher Wyss & Company, whose London offices are at 109 Victoria street, Westminster, S. W., have issued a number of catalogues illustrating their specialties, which are Zoelly steam turbines, tangential water-wheels and Francis hydraulic turbines, turbo pumps and refrigerating and ice-making plant. The catalogues are, in most instances, printed in English, French and German, and they contain reference lists of users of each class of machinery and illustrations of a number of installations.

The Combination Metallic Packing Company, Ltd., Gateshead, have published an interesting pamphlet giving a history of piston rod packings, illustrated descriptions of metallic packings for piston and valve rods of vertical and horizontal, land and marine engines are also included. The company have also issued a pamphlet dealing with the "C. M. P." metal jointing rings. These consists of concentrically-beader rings of white metal, copper, or an alloy specially suitable for use with superheated steam and high temperatures. They can be secured in either circular, oval or irregular shapes.

James Archdale & Company, Ltd., Manchester Works, Ledsam street, Birmingham, have published their new catalogue of machine tools. Illustrations with full details are given of high-speed radial drills, and also sensitive and multiple-spindle drilling machines. High-speed sliding, surfacing and screw-cutting lathes are illustrated, together with turret lathes, high-speed capstan lathes, brass finishers' lathes, horizontal and vertical milling machines, profiling and grinding machines. The catalogue also deals with pipe and bolt-screwing machines, boring machines, planing, shaping and slotting machines. The last pages of the catalogue are devoted to general information.

The Wilkinson feed-water heater is described in a pamphlet published by the manufacturer, George Wilkinson, Beech Mount, Harrogate. This apparatus is fixed within the boiler, and the functions which it is said to fulfill in a satisfactory manner are: 1. To deliver feed water at full ebullition temperature at the bottom of the boiler, thereby greatly accelerating circulation and relieving the boiler plates from undue strain. 2. To induce a chemical process, viz.: the destruction of the affinity between the various minerals which go to form scale within the boiler. 3. To remove the gases from the feed water, which are so destructive to the boiler plates. 4. To extend the ebullition area within the boiler, thereby substantially increasing both the efficiency and the output of any boiler to which it is applied. 5. To deposit the scale-forming ingredients over and around the "blow-off" cock, whence they are removed when the boiler is blown off. 6 To maintain a clean and efficient boiler throughout its period of work. 7. To deliver steam from the boiler free from air and gas, thus improving the vacuum and efficiency of the engines.

Fleming, Birkby & Goodall, Ltd., West Grove Mill, Halifax, have issued a booklet giving details and prices of their "Inextenso" leather belting. This belting is stated to be practically free from stretching; it is advertised in thicknesses varying from 4 to 7 millimeters and up to 12 inches in width. A useful table is included in the booklet, which shows the power transmitted at different speeds.

Independent air pumps and other marine specialties are the subject of Catalogue No. 5 published by G. & J. Weir, Ltd., Cathcart, Glasgow. "Weir twin type independent air pumps have been supplied by us during the last ten years to almost every important vessel built in this country and abroad fitted with independent air pumps. They have proved, in design and construction, to be thoroughly reliable and highly efficient, and remain the paramount pumps of their type. We recommend their adoption for all large installations having over 6,000 indicated horsepower in single units, where weight and space are not absolutely the first considerations."

BUSINESS NOTES

AMERICA

A handsome gunmetal watch fob will be sent free to any of our readers who will mention this magazine by the E. M. Dart Manufacturing Company, Providence, R. I.

Clement Restein Company, 133 North Second street, Philadelphia, Pa., manufacturer of Belmont packings, has opened a branch office and stock room at 11 Woodward avenue, Detroit, Mich., with Mr. E. N. Marcy, who was formerly connected with its general office, as manager.

Detroit, Mich.—B. P. Everitt, president of the Metzger Motor Car Company, has installed a six-cylinder 100-horsepower engine, made by the Buffalo Gasolene Motor Company, 1209 to 1221 Niagara street, Buffalo, N. Y., in his new 75-foot cruser yacht. As an added equipment to his yacht Mr. Everitt has purchased a 3-horsepower Buffalo combination electric light and pumping outfit.

The electric searchlight projectors, made by the General Electric Company, Schenectady, N. Y., are specially designed for the severe requirements of marine service. They are arranged for hand, pilot house, rope or electric control, and can be furnished in sizes from 9 to 60 inches. A list of installations will be sent upon request, showing the variety of uses to which these searchlights are adapted.

A free sample of Palmetto twist packing will be sent by Greene, Tweed & Company, 109 Duane street, New York, to any of our readers who will mention this magazine. The statement is made that the handiest thing on board ship is a spool of this packing, that with it you can often stop a leak almost before it starts. In one place you will require only a single strand of packing that is well lubricated and which will not burn out. In other places more. But no matter what size you require it can be obtained at once from a single spool of "Palmetto Twist."

Submarine Engineering.—Any of our readers interested in this subject should write to the Lake Submarine Company, Bridgeport, Conn., mentioning International Marine Engineering, and ask for a copy of this company's handsomely illustrated 52-page pamphlet entitled *Submarine Engineering.* The Lake Submarine Company, which was organized in 1895 for the purpose of developing by experiment the practicability of carrying on certain classes of submarine engineering works in fields previously neglected, by reason of difficulties then deemed insurmountable, is not a working company. That is to say, it does not engage in actual recovery of vessels and their cargo, nor does it become a competitor to existing engineering or recovering companies in their respective fields. It is what is known as a development or parent company. It engages in commercial work only, so far as to prove the practicability of the various inventions controlled by it and to bring those appliances through the experimental stage up to the point of mechanical success. This having been won, the company limits itself to granting working licenses to others and to protecting the licensees in the exclusive use of the apparatus or methods covered by the patents controlled by the Lake Submarine Company. This company built the submarine boat *Argonaut,* which it states is the first successful submarine boat that ever operated in the open sea.

The attention of submarine engineers, shipping men, dredging contractors and masters, who may be looking for a business, is called by the Lake Submarine Company, Bridgeport, Conn., to the great money-making opportunities which exist in modern submarine engineering—recovering wrecks and sunken cargos, removing rocks, dredging improvements, submarine tunnel construction, improving waterways, shell, pearl and sponge fisheries, etc. This company states that all classes of engineering work can be done under water with great rapidity, and without the danger incident to old-time methods, by the specially designed machinery it makes.

For the removal of scale the new Weinland quick-repair head is, according to the maker, the Lagonda Manufacturing Company, Springfield, Ohio, just the thing to use on shipboard. "There is nothing to get out of order. Extra cutter wheels can be carried, and when old ones wear dull, they can be replaced in the shortest possible time, and without the use of special tools. This head can be attached to either our air, steam, or water-driven turbine and for any sized tube. Under the action of centrifugal force the cutters bear out steadily, removing every bit of scale, but not injuring the tubes in the least."

A Fine Record for Belts.—"A little while back, the Joseph Dixon Company, Jersey City, N. J., for the first time in eighteen years, took up a belt in one of its mill rooms. For eighteen years about thirty belts in that room have been run constantly; the belts are about 25 feet in length and 6 inches in width. There is a great deal of graphite dust in the room, yet these belts have run satisfactorily without breakage or without being taken up for eighteen years. The belts are regularly treated with Dixon's traction belt dressing, which comes in paste form, and which is one of the very best leather preservative belt dressings made anywhere. Of course, there are many who find it desirable or necessary to use a solid dressing. If a quick, convenient dressing is desired, Dixon's solid belt dressing is suggested. The Dixon Company frankly state that no solid dressing equals their traction belt dressing, for the reason that some of the ingredients in their traction dressing cannot be reduced to solid form. But if the solid dressing is preferred, one may use Dixon's solid belt dressing with all safety. It is a quick, sure cure for slipping belts, but has no detrimental effect upon the belting."

Motors for commercial service are now being used in coastwise schooners, fishing schooners, towboats, oyster dredge boats, and freight and passenger service. The Standard Motor Construction Company, 180 Whiton street, Jersey City, N. J., makes a specialty of gas engines for such purposes, and builds them in sizes from 12 to 2,000 horsepower.

The Peerless Rubber Manufacturing Company, 16 Warren street, New York, has recently opened a branch office at 704 Arch street, Philadelphia, Pa. The Goodall Rubber Company, Inc., has been appointed distributers for Philadelphia and vicinity, and will carry a large stock to meet demands for the Peerless line of rubber goods.

Cut Down a 24-Hour Run to 20½ Hours.—All this was done, we are informed by the American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass., with a triple expansion engine equipped with the American-Thompson indicator, and by an engineer who had never before taken a diagram from his engine. "The engineer who accomplished this is only doing what every progressive engineer may also accomplish. The price of these indicators is $55, and they may be paid for in monthly instalments of $5 each."

The A. B. C. Engine at Sea.—Engineer DeKalb of the steamer *Riverside* owned by the Charles Nelson Company, San Francisco, Cal., writes the American Blower Company, Detroit, Mich., manufacturer of the A. B. C. engines: "I have operated large ships on the Atlantic as well as here, and would say that your engine gives no trouble and requires the least attention of any I have ever seen or operated. It is giving great satisfaction. We are proud of it. Your oiling system cannot be beaten."

Williams' "Vulcan" Auto Tool.—Convenience, service and wear are assured in this combination. The tools are drop-forged from carefully selected steel, milled and ground to correct sizes of openings, tempered, polished and blued. It is a veritable "half-pound" tool chest, replacing a dozen ordinary tools. Its usefulness and efficiency extend to all mechanical purposes—a thorough household, motor boat, etc., etc., tool. They are packed in canvas bags with button flap, and become an unusually adaptable hip-pocket companion; 8 inches length and ½ pound weight. Retailed everywhere at $1.00 each. Sold to dealers only, in not less than 1 dozen lots.

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Salesman, seeing marine engineers, wanted to handle as side line patented, well advertised, money and labor-saving device. No competition. Pocket sample. Address *Pocket Sample,* care INTERNATIONAL MARINE ENGINEERING.

Young man of 33, connected with the technical staff of various shipbuilding companies for the past fifteen years, desires to receive proposition to act as general agent, or as New England representative, for marine specialties; or would consider any Atlantic coast territory. Address *B. M. C.,* care of INTERNATIONAL MARINE ENGINEERING.

Mechanical Engineer, 35 years old, with long practical experience in the construction and design of machinery and handling men, desires active position with growing concern doing marine repair work and installing machinery. Prepared to make a modest investment. Highest references furnished. Address *Mechanical Engineer,* care INTERNATIONAL MARINE ENGINEERING.

BUSINESS NOTES

GREAT BRITAIN

CLARKE, CHAPMAN & COMPANY, LTD., Victoria Works, Gateshead, have opened a London office at 29 Queen Anne's Chambers, Broadway, Westminster, S. W., especially for the sale of the Clarke, Chapman & Company watertube boiler for marine and land installations.

AS A RESULT OF THE EMINENTLY GOOD WORK done at Bombay by the dredgers *Jinga* and *Kalu,* the builders of these dredgers, William Simons & Company, Ltd., Renfrew, have applied for letters patent for a suction hopper cutter dredger fitted with a suction pipe and cutter. This new design of vessel is called the "Simons" dredger, and incorporates a number of special features, all of which have been protected. It is claimed for this vessel, with its special fittings, that it can in most cases do the same duty as a dredger fitted with a bucket ladder and chain of buckets. But having neither upper nor lower tumblers, buckets, links, nor pins, the "Simons" dredger has not so many wearing parts as bucket dredgers, and it is therefore confidently anticipated that this new type of dredger will be much less costly in maintenance and repairs.

ARCHIBALD LOW, engineer, brassfounder and contractor, Merkland Works, Partick, Glasgow, writes us that "Low's patent radiators have now been adopted by nearly all the principal steamship companies. The principles embodied in these radiators are entirely different from all other types, as no webs are used to increase the radiating surface, but instead only prime radiating surfaces are used. Internal tubes are fitted, by means of which the air inside is heated and rises, more cold air entering at the bottom, and this in turn is also heated, thus causing a good circulation of air in the room. After exhaustive tests it had been found that Low's patent radiators will condense more steam per square foot than any other radiator, thus proving that it is the most effective on the market. The design is very ornamental, and does not require coverings as do those of the web and other types."

"THE WELL-KNOWN HOWDEN PATENT SYSTEM of forced draft, which has been in use by many of the leading steamship companies of the world for a long period of years, has for some reason or other not been adopted to any extent in dredgers. The reasons for this somewhat curious state of affairs are not apparent on the surface, for, as a matter of fact, the unique advantages which the Howden system confers in the way of great economy of fuel and increased steaming power of the boilers would be even more marked in the case of this type of vessel where the load is fluctuating and where specially heavy demands for steam are occasionally required. The magnificent results in economy and efficiency obtained in the two Bombay dredgers *Kalu* and *Jinga,* in which Howden's forced draft was fitted to the boilers, have, however, proved to the world that that system is the best method of combustion for dredger boilers as well as for the boilers of ocean-going vessels of all other types."

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
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WHITEHEAD & COMPANY, Fiume, write INTERNATIONAL MARINE ENGINEERING: "We beg to inform you that after a severe and long-drawn-out competition between all European and American constructors of submarine vessels, the Danish government has decided to order our new Whitehead type for the submarines on their navy programme."

A CORRECTION.—On page 10 of our February issue, attention was called to circulars issued by W. Sisson & Company, Ltd., Gloucester, describing marine engines for yachts, launches, tugboats, etc. The statement was made that these engines are suited for 160 pounds "water pressure," or up to, say, 200 pounds, if required. We should have used, of course, the word "working" or "steam" in place of "water."

A NAVAL, MERCANTILE MARINE AND GENERAL ENGINEERING EXHIBITION will be held at Olympia, London, W., from Sept. 21 to 26, 1910. The undertaking is receiving the support of the most eminent personages conected with naval and other branches of engineering which the exhibit will embrace, as well as the great institutions connected with engineering and with the iron and metal trades. Full information may be obtained by writing to Frederic W. Bridges, organizing manager, 119 Finsbury Pavement, London, E. C.

F. McNEILL & COMPANY, Lamb's buildings, Bunhill Row, London, E. C., write us: "We have the honor to inform you that we have decided, for family reasons, to convert this business into a private limited company, the proprietorship remaining, however, in the same hands. All debts due from or to the firm are to be paid or received by the company. The conversion will not affect the general conduct of the business, which will be carried on as heretofore, and we trust that the satisfactory relations which have always subsisted between us will be continued with the company."

TRADE PUBLICATIONS.

AMERICA

"Lifting Jacks" is the title of an attractive 100-page catalogue just issued by the Joyce-Cridland Company, Dayton, Ohio. Besides listing their complete line of jacks for all purposes, the catalogue also contains discussions of the construction and recent improvements in this line of jacks. It also discusses the relative merits of various types of jacks, such as hydraulic, lever, automatic, automatic geared, screw, telescoping, etc., for different classes of service, and recommends the most suitable jack for the different lines of work. The catalogue contains complete information concerning the dimensions, weight, price, etc., of the various jacks, and should be on file with anyone who is interested in the purchase of jacks for any purpose. Copies may be had by addressing the Joyce-Cridland Company, Dayton, Ohio.

"Graphite and Grease" is the title of a folder issued by the International Acheson Graphite Company, Niagara Falls, N. Y. "In the manufacture of our combination lubricants we blend the unctuous, pure graphite with a high-grade grease, the latter, as we have said, simply to act as a carrier for the graphite, which is a perfect lubricant in itself. This graphited grease is wholly free from the gritty impurities of lubricants containing natural graphite. It will reduce friction to the minimum, giving a large saving in the power previously lost through overcoming friction, and prevent the parts wearing away, as is the case where oil or grease is used alone. As our graphite is not crystalline, nor hard, under pressure it will move within itself like a film of oil, while it is quite impossible for bearings so lubricated to seize or cut. Because the graphite we incorporate in our greases forms the body of the lubricants, we are enabled to employ a grease of very low viscosity as a carrier, thus effecting a valuable saving in power to those who use them, while it is a fact that either grade of our graphited grease will serve for a wider range of uses than plain grease lubricants."

"Smooth-On Instruction Book," ninth edition, has just been issued by the Smooth-On Manufacturing Company, 572 Communipaw avenue, Jersey City, N. J., and a copy will be sent free upon request to anyone mentioning this magazine. "The great value of Smooth-On to the manufacturer and user, is because of its peculiar chemical properties, namely, of metalizing and of expanding when metalizing, and it can be prepared to act quickly or slowly, according to the requirements of particular uses. These properties make Smooth-On a valuable substance in the making of chemical iron cements. To this subject the chemist of the Smooth-On Manufacturing Company has given careful study for fifteen years, and has succeeded in compounding the valuable iron cements known so generally throughout the world as Smooth-On iron cements. These cements are made each for a special purpose; they are carefully prepared by a chemist, and when correctly used they make permanent repairs. The different Smooth-On cements are explained in the following pages; a careful study of them will prove interesting and profitable. The illustrations are made from photographs of actual subjects, and show some of the many ways in which the Smooth-On cements have been used and the results obtained."

Generating sets with vertical engines are the subject of Bulletin 172 of the Engineering Series published by the B. F. Sturtevant Company, Hyde Park, Mass. "The generating sets with vertical single engines described in this bulletin are the result of years of experience in building apparatus of this type. They are compact, capable of continuous operation for long periods with very little attention. They run with practically no vibration. Both the engine and generator are of high efficiency and are capable of 50 percent overload for a short period without shifting of brushes or destructive sparking at the commutator. They are capable of continuous operation at 25 percent overload without sparking or undue heating. The sub-base of the engine is extended to take the generator. Sturtevant vertical single engines, Class VS-7, are the result of over fifty years' experience in engine building, and in this type we have not tried to design a low-priced engine, but rather one that will give continuous satisfaction under all operating conditions. The VS-7 is a compact, quiet-running engine, and may be operated continuously for long periods, requiring but very little attention. It runs with practically no vibration, and the mechanical efficiency is exceptionally high. It is entirely enclosed and self-contained, and because of the large diameter and short stroke develops great power and high speed without excessive piston travel. This engine is especially adapted for direct connection to generators and all work requiring accurate regulation and economy of steam."

The illustration on the outside cover of the latest issue of *American Wire Rope News*, published by the American Steel & Wire Company, Chicago, Ill., shows the lowering of a section of the new Detroit River tunnel of the Michigan Central Railroad with "American" wire rope.

The Griscom-Spencer Company, 90 West street, New York, is distributing illustrated mailing cards calling attention to the Reilly multi-coil feed-water heater, which the manufacturer states embodies every practical and scientific requirement. "The violent agitation of the water in passing through the coils promotes rapid absorption of heat and prevents the deposit of scale or sediment in the tubes. Every coil is a spring, and therefore there is no need for expansion joints and no possibility of leaks developing through temperature strains or vibration."

Catalogue E-3 has been issued by the Boston Gear Works, Norfolk Downs, Mass. Speaking of this company's "Standard" steel gears the catalogue states: "The steel gears have been carefully designed in reference to hole, hub, face, rim, web and spoke, and fill as many requirements as possible for standard stock gears of a fixed size. The hubs are of such a size that they will stand a reasonable amount of reboring, hence the hole may be increased where necessary. Where the gears are to be furnished with a hole of a smaller size, we would recommend our standard steel bushings, as is illustrated on page 15 of Catalogue E-2. Where it is necessary to have gears of double strength we suggest the use of the double face standard pinions as listed up to a limited size, and with the larger size by placing two gears side by side. We also claim, with the list as it has been carefully studied and planned, it will be desirable for manufacturers and designers to adopt this as a standardization of gear machinery parts. The steel that we use is about three times stronger than cast iron—where the average tensile strength of the latter is about 17,000 pounds, steel of ordinary carbon is approximately 50,000 pounds—and elastic limit is so much higher that in the adoption of steel we believe we are presenting a gear product which will far surpass anything in this line on the market for ready-made gears."

Absolute Ventilation the Year Round.—"The Sirocco electric fan and air purifier is a device developed by the American Blower Company, Detroit, Mich., and Troy, N. Y., using a Sirocco standard turbine type impeller wheel but 3 inches in diameter as the basis for bringing the fan system of ventilation within the reach of every one using electric current. The small space occupied and the light weight combine to make the Sirocco device portable and attractive. On account of the high efficiency of the Sirocco fan, the electric motor is small (one-seventieth of a horsepower), and the electric current requirement almost insignificant. The complete outfit can be installed upon the window sill by the office boy or stenographer without tools. Sirocco will supply 5,000 cubic feet of fresh, filtered air every hour, diffusing same throughout the room or in any direction at will, or deflected through radiator for winter ventilation. By the simple reversal of a small lever, without changing the position of the outfit or stopping same, Sirocco will exhaust from the room the dead used-up air in the same large volume. It is not a mere agitator of the air in an apartment, and it goes beyond any other ventilating device yet made. The design has been perfected and patents applied for, and manufacturing facilities are being hurried into shape for the production of these remarkable units by the thousands. The complete outfit consists, in addition to the Sirocco fan, motor and reversing mechanism, of an adjustable outlet nozzle for summer use, speed controller, a dozen filter cloths and window sash lock, which prevents the window being raised from the exterior after the outfit is in place. There will be an immense demand for this complete unit, as it is not simply a centrifugal fan and motor but an equalizer which will reduce precisely those atmospheric conditions necessary for alert, mental and physical activity. The air supply is purer than the outer air, because of its being filtered. Sirocco enables the indoor worker literally to live and work outdoors. This is but one of the latest applications of the famous Sirocco turbine fans which are now being applied for the ventilation of kitchens, telephone booths, laundries and toilets on land, shipboard and on wheels. Sirocco fans are used almost to the exclusion of any other type for ventilating, cooling and mechanical draft on the modern battleships, cruisers, destroyers, etc., in the British, German, Italian, Russian, Japanese and United States navies. The United States ships *North Dakota* and *Delaware*, which on recent trial developed such wonderful speed, did so under forced draft supplied by Sorocco blowers, and the United States ships *Florida* and *Utah*, now under construction, are being equipped, both for hull ventilation and mechanical draft, with Sirocco fans."

The engineering specialties made by the Walworth Manufacturing Company, 138 Federal street, Boston, are described in a profusely illustrated booklet this company has just published. This booklet briefly outlines the contents of the Walworth catalogue, a copy of which can be obtained free by mentioning INTERNATIONAL MARINE ENGINEERING. This company has had an experience of seventy years devoted to the developing and manufacturing of steam specialties, such as the well-known Stillson wrench, valves of many kinds, pipe fittings, tools, engine and boiler trimmings, die plates, vises, pipe cutters, etc.

"Tacking Ship Off Shore," from a painting by W. E. Norton, has been lithographed in several colors and is used as the heading of a large and handsome wall calendar distributed by the Baldt Anchor Company, Chester, Pa.

The Marine Boiler Works Company, Toledo, Ohio, has published a catalogue describing its marine and stationary boilers of all kinds, and a long list is given of the marine boilers which have been built and installed by tihs company.

Modern steel dredges and steam shovels are illustrated in a folder issued by the American Steel Dredge Company, Fort Wayne, Ind. This folder is intended as an announcement until the company's complete catalogue is ready for distribution after the removal of its plant from Logansport, Ind., to its new and larger factory in Fort Wayne.

The merit of "Oildag" as a lubricant is the subject of a pamphlet published by the Acheson Oildag Company, Niagara Falls, N. Y. In placing Oildag on the market as a new lubricant, the manufacturer calls attention to the report of Prof. Charles F. Mabery and that of the special graphite committee, and the technical committee of the Automobile Club of America, which are reprinted in this pamphlet.

The Dunlap Engineering Company, successor to the Columbus Pneumatic Tool Company, Columbus, Ohio, has issued a handsome catalogue describing its close-quarter drills, central spindle and reversible type of drills. The latter is a device partaking something of the nature of reversible valve gearings, and said to be simple and durable. Those interested should write for a copy of Catalogue No. 20 and mention this magazine.

The Newcycle motor, which is said to be an improved type of gas, gasoline and oil engine, is described in circulars distributed by the Newcycle Motor Company, 39 Cortlandt street, New York, and full information relative to this engine may be obtained by addressing the company, which had in aim, when designing the engine, "to secure the advantages of the frequent explosions obtained in a two-cycle engine without sacrificing the positively-controlled action and consequently more reliable performance of the four-cycle type."

The nineteenth annual report of the board of directors of the Philadelphia Bourse for the year ending Dec. 31, 1909, was submitted to shareholders May 10, 1910, and shows the company to be in the most prosperous condition. The exhibit department of the Bourse presents an opportunity to marine engine and boat builders, boiler makers, machine tools manufacturers and others to maintain a permanent exhibit in the Bourse, where they will come in contact with buyers from all over the country. Full information may be obtained by addressing the Bourse, Philadelphia, Pa.

TRADE PUBLICATIONS

GREAT BRITAIN

"Victor" arc lamps for direct-current circuits are illustrated in a catalogue issued by the Electric & Ordnance Accessories Company, Ltd., Aston, Birmingham. The carbons of these lamps are fed by a clutch controlled by a series coil. Standard enclosed lamps for general illumination and inverted and ship's deck types are described in the list, which also gives details of flame and miniature arc lamps.

Pneumatic hoists are the subject of Section 5 of the catalogue issued by the Consolidated Pneumatic Tool Company, Ltd., Palace Chambers, 9 Bridge street, Westminster, London, S. W. Regarding this company's pneumatic geared hoist the statement is made: "These hoists can be fitted with an automatic air-actuated brake when it is absolutely essential to sustain the maximum load indefinitely, thus making it particularly adapted to serve machine tools, riveting and punching machines in boiler shops and bridge-building works. The hoist operates by a pneumatic motor through a chain of gears cut from solid steel, which sustains the load with absolute safety, without dependence on the brake, unless it is intended to carry a load suspended indefinitely, when a slight setting takes place, in which case a brake is necessary. The brake acts on a disc keyed to the highest speed shaft, or train of gears, by means of a leather diaphragm of suitable diameter to furnish the necessary frictional resistance to sustain the load; air is admitted to the back of the diaphragm by special ports cut in the main admission valve, so arranged that when the hoist is shut off air is constantly pressing on the back of the diaphragm, but the first movement of the slide valve tending to start the hoist releases the brake, thus making it impossible to stop the hoist without the brake acting."

The Empire Roller Bearings Company, Ltd., 15 Victoria street, Westminster, S. W., have published a sheet giving particulars of a series of roller bearings for trucks, mine tubs, skips and wagons generally, and of another series for railway trolleys, inspection cars, trucks, etc., which have to be dismounted quickly from their axles. The special advantages of these bearings are that they considerably reduce the power required for haulage and also save a good deal in lubricants.

The Appleby Crane & Transporter Company, Ltd., have, among recent orders, secured a contract for five 63-foot portable Temperley transporters for the Cadeby Colliery Company; two 60-foot similar transporters for Messrs. Vickers Sons & Maxim; two 55-foot, with 10-inch by 10-inch engines, for the Chilian Naval Commission, and four of 60 feet for the Denaby Coal Company, all of which are for coal handling. The firm have also a large gantry coaling crane in construction for South America, as well as a number of large power overhead travelers. A 25-ton traveling gantry crane, with a radius of 90 feet, which the firm are building for the Avonmouth Dock, Bristol, is now practically completed. It is one of the largest cranes of the type in Great Britain.

Steam specialties are the subject of a catalogue issued by the Yorkshire Boiler Company, Ltd., Standard building, City Square, Leeds. Regarding the Yorkshire boiler, their catalogue states: "The Yorkshire boiler is the invention of W. H. Casmey, A. M. I. M. E., of Leeds, and was introduced nearly two years ago, and there are now more than twenty of these boilers under steam giving every satisfaction. It will be seen that the Yorkshire boiler is a modification of the Lancashire, but that it is shorter in proportion to its diameter, the ratio of length to diameter being as 5 is to 2. Its flues rise slightly from front to back, and expand from the end of the furnaces to the down-take in the proportion of 5 to 6; that is, the sectional area of the flues at the rear is about 33 percent greater than at the front, and this has the effect of locating more water directly over the points where the larger proportion of heat is transmitted to the boiler than at any other part."

Pneumatic tools are described in an illustrated catalogue published by Balcke & Company, Ltd., 27 Clements Lane, London, E. C. "We have pleasure in submitting herewith our latest catalogue of the Empire pneumatic tools and appliances, which have been specially designed to meet the greatly increasing requirements of all the most modernly-equipped shipbuilding, railway and general construction and engineering work. A careful perusal of the contents will show that special attention has been given to the design of the tools described and illustrated therein, and the simplicity of design, high-class workmanship and working capacity of the tools, represent the very latest development in this branch of engineering. In comparison with other pneumatic tools and appliances it will be found that the consumption of air is lower, the working capacity of the tools is greater. the liability to get out of order, owing to the simplicity in construction, is greatly reduced and the cost of up-keep is thereby reduced to a minimum. The range and power of the tools is capable of a wide adjustment and within the perfect control of the operator. There is practically no recoil—a fact that makes this tool more popular with the workmen than those of any other manufacture at present on the market. We shall be pleased to prepare and submit estimates for complete plants on application, and at the same time are prepared to send an expert to demonstrate any tool and advise upon the most suitable plant for the class of work to be undertaken."

An engineers' handbook to Weir's marine boiler feeding specialties has been published by G. & J. Weir, Ltd., Cathcart, Glasgow. This is an illustrated pamphlet of 76 pages, and gives a complete description of the various marine specialties this firm makes.

Messrs. Alfred Herbert, Ltd., Coventry, have recently published the eighth edition of their catalogue, section H, which deals with the "Coventry" self-opening die heads. These die heads are made to take work from ½ inch to 4½ inches. The catalogue describes the make of the special features of the straight-cut dies, several illustrations being included. Complete instructions for grinding the dies are given, and a special fixture enabling all four dies to be ground at once on any surface or cutter grinding machine is also shown.

J. Beardshaw & Son, Ltd., Baltic Steel Works, Sheffield, have recently published the third edition of a valuable little book of notes on high-speed tool steel. The book deals principally with "Conqueror" brand of steel, and gives details as to forging, hardening and annealing this material; results of tests on drills and lathe tools made from it are included. Tables of speeds and feeds for twist drills and cold saws are also given. The book also contains notes for the treatment of ordinary crucible steels, and a special alloy known as chrome steel, principally used for turning tools. The booklet has some space devoted to Beardshaw's profile steel, which is rolled in various special sections.

Messrs. James Munro & Company, Ltd., 101 and 103 King street, Tradeston, Glasgow, have favored us with a copy of their Tempometer or Horometrical Chart which they recently issued. The chart is substantially a dial, well printed in colors and mounted on a stout card, in the center is a revolving disc. The disc indicates the local mean time, latitude and longitude of all the principal cities and towns. A very ingenious calendar is also contained as the chart, by which the years, months, weeks and days since the introduction of the new method of time into Britain (1752 A. D.) and onwards, are displayed as in an ordinary calendar. The tempometer, which is artisically and attractively got up, should prove of very great use in the offices of all shipowners as well as on board ships. The chart can be obtained from Messrs. Munro & Company at 2s. 6d. on stout card, or 5s. framed in polished oak or other rich wood.

Temperley Transporters are illustrated and described in a new list of Messrs. Applebys, Ltd., 58 Victoria street, Westminster, S. W. Temperley transporters are practically a combination of crane and conveyor, and are used in all parts of the world for loading and discharging vessels, coal handling, etc. A large number of illustrations are shown of the transporters unloading and storing grain in sacks, raising coal from railway trucks, and carrying out many other duties of which they are capable.

Messrs. Atkinson Bros., Aire Place, Kirkstall road, Leeds, have issued circulars dealing with their specialties; among these a three-speed, electrically-driven sensitive drill is illustrated. This particularly tool is produced in three sizes for drilling holes of diameters up to 5/16 inch, ½ inch and 1 inch. Prices of small electric motors and electrically-driven polishing machines are also given. Box-blade fans, ceiling fans and blowers, screwing machines, a motor-driven hacksaw, and a sensitive drilling machine for belt-driving are also dealt with.

Marshall, Fleming & Company, Motherwell, Scotland, have issued an excellent and well-bound catalogue which illustrates and describes the different types of cranes manufactured by this well-known Scottish firm. Among others the list gives types of overhead electric travelers, overhead hand travelers, locomotive steam cranes, electric Goliath and cantilever cranes, electric wharf cranes, special cranes for iron and steel works, electric cranes for charging soaking pits, electric ladle cranes, electric cranes for ingot stripping and electric cranes for clearing pig ends. The catalogue is well got up, and apparently a great deal of care has been expended in its production.

Mitchell's Emery Wheel Company, Mill street, Bradford, Manchester, have issued a catalogue of their grinding and polishing machinery and materials. The list deals with plain emery and corundum wheels and special wheels for tool-grinding machines. Illustrations are also included of several wet and dry grinding machines, twist-drill grinders, face, wheel and disc-grinding machines and polishing machines. The majority of the machines are fitted with long, cast iron, ring-lubricated bearings, which Messrs. Mitchell find give excellent results. Prices are quoted for the machines and grinding wheels, and also for abrasive papers and cloths, polishing bobs and mops and various supplies.

BUSINESS NOTES

AMERICA

BRUNSWICK, GA.—E. T. Stevens will change the power in his 50-foot cruiser *Annie*, taking out twin-screw 6½-horsepower engines and installing a four-cylinder, 24-horsepower "Buffalo" of the heavy-duty type.

A PRESERVING AND ANTI-FOULING COMPOSITION for preserving all submerged structures of steel, iron or wood has been invented by M. H. Devey, 2901 Ridge avenue, Philadelphia, Pa. "This composition has been needed long by all railroads and steamship owners. Paints do not give the desired preservation they need. While in fresh water this is true, in salt water it is much worse, for the acid of the salt water works destruction to the steel or iron sooner than fresh water. We have facts to prove that after years of labor to give something better than paints (and we have surely succeeded) we point to actual tests. We have preserved steel plates in salt water for eighteen months at Norfolk, Va., back of the navy yard, and when taken up were in good condition and not a barnacle thereon, the composition in good condition and the steel plates in as good condition as could be, and also on a lead keel, where nothing else would stay on. This proved highly satisfactory on the yacht of Mr. Francis Shunk Brown, of Philadelphia. Our shipowners know of the great cost to them of frequently docking their steamers, for to neglect this means the destruction of them much sooner and more expense in running them with foul bottoms. This composition contains no lead, with its bad features, and it does not peel off as lead or crack. A plate beat with a hammer on the opposite side from the composition does not loosen it. This preservation for metals has nothing to compare with it. Its durability is unapproachable. Who ever heard of a steel plate two years immersed in salt water and none the worse? We believe a ship's bottom can be kept clean that length of time. Its anti-fouling features are marvelous. It is made of those things which are unaffected by acids. Lead is one of the worst things to put in paint or any composition, yet this article stayed satisfactory where everything else failed for over a year, and was asked to do the trick again."

RAY D. LILLIBRIDGE, INC., advertising managers, have moved from 100 Broadway to larger offices at 192 Broadway, in the Chatham National Bank building, New York.

THE NATIONAL ASSOCIATION OF ENGINE & BOAT MANUFACTURERS has moved from 314 Madison avenue, New York City, to the Engineering Building, 29 West Thirty-ninth street.

THE KERR TURBINE COMPANY, Wellsville, N. Y., has arranged for presentation in two more American and three foreign cities as follows: San Francisco and Oakland, Cal., United Iron Works; London, England, Economical Gas Appliance Construction Company, Ltd.; Mexico City, J. H. Bloomberg; Sidney, N. S. W., A. F. Partridge. With the above the Kerr Turbine Company now has active representatives in twenty-six cities. The use in Europe of American turbine units of the small sizes built by this firm would hardly seem to warrant representation on the other side, but numerous Kerr turbines have been sold in England alone, one customer there having bought seven on repeat orders.

REPORT BY A COMPANY THAT MAKES THOUSANDS of large bells annually of a comparative test between Victor vanadium bronze and their standard bell metal: "In response to your request would advise that the six sample vanadium bells have been received, machined up and proved very satisfactory. After mounting and testing for sound, we determined that these bells have a clearer and much better tone than any bell which we have heretofore examined. The physical test of these bells showed remarkable results and were superior in every respect to the bells made from our own mixture—82 percent copper and 18 percent tin. The vanadium bell was struck twelve blows with the face end of a sledge hammer at "*A*" (as marked in above sketch) without any evidence of failure. It was then struck thirty blows at "*B*" without any evidence of failure. The bell was then placed under the steam hammer and distorted in the shape shown in above sketch without any evidence of failure. The bell made from our standard mixture was struck twelve blows with the face end of a sledge hammer at "*A*" without any evidence of failure. It was then struck twice at "*B*" with the peen end of the sledge, and cracked at the second blow. The bell really cracked with one blow, as the first blow scarcely nipped the edge of the bell, while the second blow, which was a true one, cracked the bell to the extent shown in sketch No. 2."

THE INGERSOLL-RAND COMPANY announces the removal of its Chicago office from the Old Colony building to the People's Gas building, suite 1503-7, 150 Michigan avenue.

PROPELLER WHEELS FOR THE ARGENTINE BATTLESHIPS.—The Bayonne Casting Company, Bayonne, N. J., has received the contract for twelve Monel metal propeller wheels for the two Argentine battleships now under construction at the yards of the Fore River Shipbuilding Company, Fore River, Mass., and the New York Shipbuilding Company, Camden, N. J. These wheels will weigh approximately 15,000 pounds each, making a total weight of 180,000 pounds, and will be cast in one piece. Six wheels are to be delivered during the current year and the balance in 1912. This is said to be the largest contract for Monel metal castings ever let.

FIVE DOLLARS DOWN secures the American-Thompson indicator, made by the American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass. This company states to engineers: "We believe that you want an indicator. We believe that you want the best. The price of the American-Thompson is $55 complete with fittings. (New improved detent motion extra.) If you remit the full amount on first payment we will send you one of our vest pocket speed counters free. If you will send us proper references and a payment of $5 we'll ship you the instrument and accept monthly payments of only $5 to cover the balance. We'll include a fine 200-page instruction book free. A $5 payment, then, secures you the instrument at once, ready for immediate use. By the time you've paid for it it will have paid for itself many times over. This is a great opportunity. It puts the best indicator in the world within the reach of every man who accepts our offer now."

BUSINESS NOTES

GREAT BRITAIN

CROSS CHANNEL SERVICE.—The Belgian government, in order to maintain the fleet of mail steamers running between Ostend and Dover in the front rank of high-speed channel mail boats, has recently had two new turbine steamers put in hand by the Société John Cockerill, of Antwerp. The first of these two new boats, the *Jan Breydel*, went through a course of trials on the Clyde on the 12th of April, when she attained an average speed of 24.9 knots at the measured mile. This steamer has an over-all length of 361 feet, beam 40 feet and a depth of 23 feet. The arrangements for passengers are second to none in the Channel service, the decorations are of a highly artistic character, and are not exceeded in beauty and good taste, even by the floating palaces traversing the Atlantic. The machinery consists of one high-pressure and two low-pressure turbines on the Parsons system, each driving its own line of shafting and propeller. The condensers are of Messrs. Weir's uniflux type, and on trials gave a very high vacuum, thereby conducing to the speed attained. The air pumps, of the "Dual" type, circulating pumps, feed pumps and all service and auxiliary pumps are of Messrs. Weir's latest design and make. The boilers, eight in number, are of the Scotch type, and worked under Howden's forced draft, and the electrically-driven fans and fittings were supplied by Messrs. J. Howden, of Glasgow.

THE *London Times* in a recent issue said: "A machine tool which is now receiving extended adoption in shipbuilding yards where naval vessels and the higher class of ocean mail and passenger ships are produced is Arthur's patent bending and straightening machine, mainly designed for the rapid and accurate curving and straightening of beams, stringer bars, etc., of any section, and in the cold state. As distinguished from the horizontal reciprocating push or squeezing machine commonly in use for this purpose, the Arthur machine has three vertical rollers as its main working feature. Being self-feeding, it dispenses with the men required to push or pull the bar, as in the case of the squeezing machine. It also renders "furnacing" unnecessary, thus obviating the extra cost of fuel. In the works of Messrs. Vickers Sons & Maxim, at Barrow, where the machine driven by a 30-horsepower electric motor has been at work for some considerable time, the heavy beams of the protective decks of warships have been successfully bent cold to their proper curvature. Machines are also employed by Messrs. Beardmore & Company in their Dalmuir yard, and by Scott's Shipbuilding & Engineering Company, of Greenock. There is every likelihood of the machine being made of a form and calibre capable of dealing with the frames of ships while cold. One of the Arthur machines is installed in the Vulcan Works at Stettin, and another is being built by the makers—Messrs. Smith Bros. & Company, of Kinning Park, Glasgow—for the yard of Messrs. Blohm & Voss, Hamburg. Shipbuilders in Holland contemplate the application of the machine to the work of cold bending the frames of cargo barges having a carrying capacity of from 6,000 to 8,000 tons."

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

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WE UNDERSTAND that Messrs. David Brown & Son, Ltd., of Huddersfield, have transferred their East Parade Pattern Works to Lockwood, where new shops, covering an area of 14,000 square feet, have been erected adjacent to their foundry and gear works. We gather that in their pattern-making department the firm is very busy on all classes of work, from motors to large marine turbines.

MESSRS. CAMMELL, LAIRD & COMPANY, LTD., have an important exhibit at the Buenos Aires Exhibition. A good deal of prominence is given to groups of locomotive, carriage and wagon tires and axles, wheel centers, boiler and dome rings, various classes of springs (laminated, spiral and volute) and buffers, with due regard to types mostly in use on the railways in Argentina. A special feature is made with three tested tires of high-tensile quality. The firm also exhibit their celebrated tool, mining and other steels. One remarkable test piece is shown of their high-tenacity steel, manufactured specially for automobile work, giving a tensile strength of 72.14 tons per square inch, with an elastic limit of 66.1 tons per square inch and an elongation of 16 per cent in 2 inches. Torsional tests on this same material are also shown. Turnings taken from an 18-inch diameter nickel-steel shaft, of 0.338 percent carbon and 3.70 percent nickel, record the durability of their "Cyclone" high-speed steel. The cutting speed under which these were taken was 20 feet per minute, the traverse ¼ inch and depth of cut 5/16 inch. The turnings were taken off after the tool had worked a distance of 8 feet without regrinding, the appearance of the tool at this stage showing no signs of falling down. We understand that Messrs. Cammell, Laird & Company have had a large business connection with South America for nearly fifty years.

TRADE PUBLICATIONS.

AMERICA

Ready-to-run ventilating sets are described in Bulletin 108-O issued by the B. F. Sturtevant Company, Hyde Park, Mass. This is a compact and efficient portable ventilating set for ship ventilation. It is used in staterooms, engine rooms and galleys, and is so light that it may be easily carried around. The B. F. Sturtevant Company states that it has sold hundreds of these sets to the United States navy, and that they have proved themselves capable of continuous and reliable operation. They are built in three sizes for furnishing from 75 to 400 cubic feet of air per minute.

"High Vacuum Surface Condensers for Steam Turbines" is the title of Bulletin "M-E," just published by the Wheeler Condenser & Engineering Company, Carteret, N. J. "The high steam economy obtained by steam turbines with vacuums of 28 to 29 inches is pointed out, while on the other hand it is shown that in obtaining these high vacuums there should be no unnecessary power consumption by the condenser auxiliaries, or excessive amounts of water used for cooling purposes. This pamphlet describes arrangements of the tube surface, the use of rain plates and other means recently devised for obtaining these results. The construction of the Wheeler dry tube condenser is the outcome of investigations into the several factors affecting transmission of heat through condenser tubes, such as the material and cleanliness of the tubes, the velocity of water within the tube, the velocity of steam against the tube, the percentage of air in the steam surrounding the tube, and whether or not the steam side of the tube is flooded with water. Copies of this bulletin, which is illustrated by numerous photographs and drawings, will be sent upon request by the Wheeler Condenser & Engineering Company, of Carteret, N. J."

Electric searchlights are described in a pamphlet published by the Carlisle & Finch Company, 234 East Clifton avenue, Cincinnati, Ohio. "The Carlisle & Finch searchlights enjoy a reputation second to none. They are the most widely known and most popular searchlights on the market. Of late years almost no other searchlight has been sold, and they are specified by practically all of the yacht and launch building companies. They are made in different sizes, from 7 inches diameter to 38 inches diameter. This pamphlet is devoted to the description of the 7-inch and 9-inch sizes only. Our complete Catalogue A contains lists and dimensions of all sizes. The well-known carbon feeding mechanism, which has created such an enviable reputation, is used in the 7-inch and 9-inch sizes. It is an improvement on the 1908 type, in that both automatic and hand feed is provided. The 7-inch size consumes from three to five amperes; the 9-inch size from five to ten amperes. Both sizes are furnished with high-quality mangin mirrors, and are provided with focusing screws, to bring the electric arc in the proper position. The cases or cylinders are made of polished brass."

"The Discovery of the Herrick Balanced Rotary Engine" is the title of a 54-page pamphlet published by the Herrick Engine Company, 74 Broadway, New York. "The Herrick balanced rotary engine has been subjected by Gerardus Post Herrick, the inventor, and his associates, to tests which establish its commercial economy and reliability. An engine was built and run for 1,685 hours to produce current, under ordinary commercial conditions, for lighting the Degnon Contracting Company's plant in Forty-second street, New York. Frederick L. Pryor, M. E., professor of experimental engineering, Stevens Institute, has tested the engine in the Carnegie Laboratories and by its endurance run at the Degnon plant. Other impartial authorities, such as Luther D. Lovekin, chief engineer New York Shipbuilding Company; G. R. Henderson, M. E., New York, and F. L. Stevenson, chief engineer International Harvester Company, have investigated the engine in actual service. The statements of all the engineers who have seen it would seem to establish beyond controversy that the Herrick balanced rotary engine: *a*, occupies small space; *b*, is the cheapest to construct and maintain; *c*, maintains reasonable steam economy; *d*, furnishes a direct drive at the advantageous speeds between those of the reciprocating engine and the turbine; *e*, is free from vibration; *f*, is easily reversed; *g*, can be compounded advantageously; *h*, is especially adapted to superheat and high pressures, and therefore, *i*, where highest fuel economy is desired will (in combination with any good turbine properly designed to utilize the steam from its exhaust), give a cheaper installation with a better economy than any at present known. The facts on which these apparently radical claims are based and also a brief survey of the commercial possibilities of this engine are developed in the following pages."

Steel boats for export, "knockdown" or sectional, are described in literature published by the Charles Ward Engineering Works, Charleston, W. Va. This company makes water-tube boilers, marine engines and light-draft river steamers.

The benefits of graphite lubrication are described in booklet No. 75-C, distributed by the Joseph Dixon Crucible Company, Jersey City, N. J. On shipboard, Dixon's flake graphite is stated to provide lubrication for cylinders and bearings without injuring the boilers if carried over to them.

Catalogue K describes and illustrates the Weinland boiler-tube cleaners with the Weinland quick-repair head, manufactured by the Lagonda Manufacturing Company, Springfield, Ohio. These tube cleaners will be sent on trial to responsible parties.

"Mercuri-Film" is the subject of a pamphlet published by Green, Hook & Company, 418 South Charles street, Baltimore, Md. The claim is made in this bulletin that the mercuri-film compounds when added to the feed water of boilers, improve steam economy and prevent danger and repair expenses, otherwise caused by feed-water impurities in the boilers.

The Kerr turbo-fan, made by the Kerr Turbine Company, Wellsville, N. Y., is described in bulletins this company has published. One of these fans is stated to be supplying 11,300 cubic feet per minute at 1,325 revolutions per minute and against 2 inches static head of water on the *Mary F. Scully,* which is the largest ocean-going tug afloat.

Chain blocks and electric hoists are the subject of a booklet published by the Yale & Towne Manufacturing Company, 9 Murray street, New York. "Some loads require to be moved vertically; this implies hoisting. Others require to be moved horizontally; this implies trolleying. Many require to be moved both vertically and horizontally; this implies the combination of a hoist and a trolley, the latter running on a crane or track. This folder deals briefly with chain blocks and electric hoists for lifting, and with trolleys, overhead rail and light cranes for horizontal transfer. If fuller information is desired, we will be pleased to send our larger catalogue on application. The three types of Yale & Towne blocks (triplex, duplex and differential) all sustain the load automatically; in the triplex block friction is reduced by using a sustaining mechanism separate from the hoisting gear."

Pump Catalogue 46, published by the De Laval Steam Turbine Company, Trenton, N. J., describes the De Laval steam turbine-driven boiler feed pump. This pump contains no valves and no packings, except the small ones around the shaft. The moving parts simply revolve and, excepting the shaft, do not come into contact with the other parts, so that wear is reduced to a minimum. Moreover, all parts and passages are at once accessible and can be easily renewed after the breaking of one joint and the lifting of the pump case cover and bearing caps. It is not necessary to disconnect the suction and discharge piping. It is stated that this pump will run with the hottest water without giving trouble and without shock or pulsation in the feed lines, and that with an ordinary pump governor it will maintain a fixed pressure of a fixed excessive pressure as desired. The steam end may be operated under live or exhaust steam or under both together, as required.

A tilting crucible melting furnace is the subject of Bulletin P-8, issued by the Rockwell Furnace Company, 26 Cortlandt street, New York. "This furnace has many advantages and will be readily appreciated by up-to-date foundrymen. The crucible is not removed from the furnace chamber, the metal being transferred to a heated crucible or ladle, as preferred, and then to the molds. After first heat the metal is always charged into hot crucible, which greatly facilitates the melting and insures maximum life to crucibles. The burner, which is operated with an air blast of but 12 ounces, makes but little noise. The furnace is so constructed with a combustion chamber in the rear that the flame projects downward against the bottom of the chamber and not against the crucible, insuring long life to same. In case the crucible breaks during a heat, the metal is all retained in the furnace and will not run on the floor; the heat may be continued as though the crucible had not been broken, and the metal poured the same as in the open-flame furnace. This feature is a great advantage over any other type, as the low blast does not injure the metal, all of which is retained in the furnace; the heat is not lost, enabling the molds to be poured promptly as though nothing had happened, as well as eliminating the annoyance and expense of removing a mass of metal from the floor around the furnace. This enables the operator to get several heats from a crucible after it would otherwise be abandoned for fear of breaking."

A boiler tube stock list is published by D. F. Cooney & Company, 88 Washington street, New York. This is a complete list of standard and extra gage boiler tubes and standard steel boiler tubes. A free copy will be sent to any of our readers mentioning this magazine.

Air compressors are described in bulletins published by the National Brake & Electric Company, Milwaukee, Wis. This company's compressors are built in stationary and portable types, for operation on either direct or alternating-current circuits. They are of the single-stage type, and are built to stand hard service and usage. Automatic starters, which start and stop the compressors and keep the air supply within the desired range of pressure, are furnished with each compressor. These machines are built in capacities of from 11 to 300 cubic feet of free air per minute.

Twist drills, reamers, chucks, milling cutters, taps, dies, machinery and machine tools are described and fully illustrated in a very complete catalogue of 360 pages published by the Morse Twist Drill & Machine Company, New Bedford, Mass. This catalogue should be in the hands of every user of such tools, and a copy will be sent free to any of our readers who will mention this magazine. A large number of new tools are illustrated in addition to the line which the company has been manufacturing for many years. Especial attention is called to the "Twentieth Century Drill," the body and shank of which are ground on centers after hardening, thus ensuring its running true and accurate to size. The large amount of radial clearance lessens to a great degree the friction of the drill in the hole.

Combination punching and shearing machine No. 246-B is one of the numerous machines described in Catalogues A and B issued by the Schatz Manufacturing Company, 14 Fairview avenue, Poughkeepsie, N. Y. Among the numerous advantages claimed for this machine are a device for separating the plate; easy feed of plates; cutting angle, T-iron round and square bars without changing cutters; mitering attachment for cutting at an angle of 45 degrees, which is said to be indispensable for frame making; patented stripping-off device for Universal punching machines, rotatable in a complete circle and vertically adjustable; punches held with key, permitting rapid changes; no delays and annoyances as with screws; a device for setting and holding down the punch over the marked hole for accurate work; mistakes impossible. This machine is built in seven sizes.

Pneumatic and hydraulic riveters are described in bulletins published by the Hanna Engineering Works, 2905 Elston avenue, Chicago, Ill. "Hanna meters drive absolutely tight rivets with every stroke, because maximum pressure is reached at one-half piston travel and uniformly maintained throughout balance of stroke. No adjustment necessary for ordinary variations. You cannot obtain tight rivets without a known pressure. We give it to you. Obviates entirely the necessity of cutting out and redriving loose rivets. Reduces the cost of pneumatic hammer riveting fully one-half. A practical substitute for the hydraulic outfit at materially reduced initial cost. Price within the reach of the smallest boiler or structural shop. Hydraulic results guaranteed, due to the Hanna motion. It is distinct. Don't confuse it with any other. There is nothing else like it. Every riveter carries with it the guarantee of Hanna results. Any rivet user can tell you what that means. In asking for prices, etc., give reach, gap, size or rivets and class of work."

The Wernicke boiler tube cutter is described in circulars issued by Joseph T. Ryerson & Sons, Chicago, Ill. "This machine has the advantage over other types of tube cutters now on the market, in that with one size tool any size tube from 1¾ inches up to 4 inches in diameter may be cut off. This is accomplished by attaching various sized bushings on the cutter end of the machine, so as to bring the cutting wheels out in contact with the inside of the tube to be cut. The machine is regularly furnished for cutting off 1¾-inch tubes, and extra bushings for cutting off other sizes can be furnished at a slight additional cost. The machine will cut off tubes either inside or outside of the boiler head, and any distance from the head desired. When desired, a ratchet handle can be provided to facilitate cutting through the larger size tubes, and it is also possible by purchasing an expander attachment, to use the machine as an expander on tubes up to 3 inches in diameter. Each machine is provided with an adjustable gage to regulate the distance the tubes are to be cut off, so that all tubes may be cut off the same length. The machine is made of the best material throughout, and is very rapid in operation. We will be glad to furnish discounts and any further information desired."

TRADE PUBLICATIONS

GREAT BRITAIN

Swan, Hunter & Wigham Richardson, Ltd., Wallsend and Walker-on-Tyne, ship and floating dock builders and repairers, have published a neat cloth-bound booklet describing and illustrating the company's shipyard and dry docks, and there are also half-tone cuts of a number of the large vessels built in this yard, among them being the Cunarder *Mauretania*.

Ships, yachts, boats and engines are described in an illustrated catalogue published by Forrestt & Company, Ltd., the Shipyard, Wyvenhoe, Essex. "Few firms, in the same way of business, can date their establishment back so far as Forrestt & Company, Ltd. The firm was founded in the days of the second Pitt; in fact, in the very year (1788) when that eminent minister backed Wilberforce's bill for the abolition of slavery. It is a noteworthy fact that the year in which Wilberforce converted Pitt to the necessity of introducing a measure for the suppression of the slave trade should also have witnessed the birth of a firm which has since been entrusted with the execution of numerous orders for vessels intended, among other purposes, to assist in suppressing slavery on the African Continent, and otherwise to facilitate the spread of civilization. The firm was established in 1788 by Mr. Thomas Forrestt, to carry on the business of ship, yacht and boat-building; and after his death the business was conducted by his two sons, Mr. T. Forrestt, Jr., and Mr. W. A. Forrestt. Thenceforward the growth of the firm was gradual, and for a hundred years a continuously enlarging business was carried on at different yards—chiefly at Norway yard, Limehouse. The sons of the founder died in 1875, and the business was subsequently converted into a limited liability company under the style of Forrestt & Sons, Ltd., and has recently (1904) been reorganized and transferred to a new company, now known as Forrestt & Company, Ltd."

The Wilkinson thermal column is described in literature published by George Wilkinson, Beech Mont, Harrogate. "It is well known that the losses by condensation in steam pipes are heavy, but it is not generally recognized that, in an average-sized boiler house, the losses in fuel and water, due to this cause alone, reach a sum approximating to £30 or £40 per annum, and frequently more. With the exception of one or two crude, unreliable and inefficient methods of returning the water of condensation to the boilers, which are expensive and little used (although they have been well known for years), the ordinary method of clearing the pipes of water is by means of 'steam traps,' of which there are many types, all ranking amongst the most wasteful devices used in connection with steam generating plant. This statement is made without fear of contradiction, and is self-evident, inasmuch as the highest temperature of water at atmospheric pressure is 212 degrees F., whereas the temperature of water within steam pipes at, say, 180 pounds pressure, exceeds 370 degrees F.; moreover, the said steam traps deliver their water (less the considerable amount lost in evaporation into the atmosphere) into drains and thence to the hot well, where it is mixed with the boiler feed water, with which it is finally pumped back to the boilers. The time which elapses while this transit is takng place allows the water to cool to such an extent that its heat is almost, if not entirely, lost in the process. Again, examination of steam plants will, in nine cases out of ten, reveal the traps in a leaky condition, blowing live steam wastefully into the atmosphere, and they are a constant source of expense and trouble. These troubles and heavy losses can be almost eliminated by the installation of the 'Wilkinson' thermal column."

BUSINESS NOTES

AMERICA

A free working sample of "Palmetto" packing will be sent to any of our readers upon application to Greene, Tweede & Company, 109 Duane street, New York.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, Jersey City, N. J., the old board, consisting of Geo. T. Smith, William Murray, William H. Corbin, Edward L. Young, Geo. E. Long, William H. Bumsted and Harry Dailey, were unanimously re-elected. The board of directors re-elected the former officers, namely, Geo. T. Smith, president; William H. Corbin, vice-president; Geo. E. Long, treasurer; Harry Dailey, secretary; J. H. Schermerhorn, assistant treasurer and assistant secretary. William H. Corbin was also re-elected as counsel. The stockholders present expressed themselves as thoroughly satisfied with the management of the company by its officers. Of the total number, 10,000 shares, there were represented 8,856 shares.

Lucuis I. Wightman, for the past six years advertising manager for the Ingersoll-Rand Company, 11 Broadway, New York, has resigned his position, to take effect August 1. He will open an office in New York City as an independent specialist in machinery advertising, handling the accounts of manufacturers of machinery and engineering products. Mr. Wightman brings to his new enterprise qualifications peculiarly fitting him for this line of work. To his long experience in managing one of the largest advertising accounts and publicity departments in the machinery field, he joins a prior experience of years in practical mechanical and electrical engineering, construction work, machine design and manufacture and machinery selling. He is a graduate engineer, the author of a text-book on compressed air, and one of the authorities on compressed air subjects. His broad acquaintance in the world of trade and technical journalism, his understanding of advertising mediums and methods, and his intimate knowledge of engineering in many phases should prove valuable to those whose advertising accounts are placed in his charge.

The Parsons Marine Steam Turbine Company, Ltd., 97 Cedar street, New York, announces that the total horsepower of Parsons marine steam turbines built and under construction is approximately 4,000,000, and that this includes a total of about 310,000 horsepower built and under construction for warships of the United States navy.

The Use of Rawhide Pinions on Vibrating Metal-to-Metad Gear Drives.—Rawhide pinions are usually considered merely as a means of stopping noise on medium and high speed drives, and by far the largest percentage of them is used for that purpose. It is a matter of engineering experience, however, that rawhide is beneficial on gear drives where there is vibration from irregular load, etc. This is well illustrated in the instance of the 1,750 gallon quintuplex pump in the power plant of the Parral Power & Reduction Company, Parral, Chihuahua, Mexico. This pump is geared through double reduction to an induction motor and furnishes the circulating water for the condenser. Originally this pump was driven entirely by cut steel pinions and cast iron gears. The pump was of so light a pattern that there was considerable spring in both shaft and frame. The result was constant annoyance from broken gear teeth, and in addition to gear renewals, there was quite an expense due to the power loss of running the engines non-condensing while pump repairs were being made. The chief engineer had about decided to abandon the pump and replace it with another of different design, when someone suggested the use of rawhide pinions. Accordingly, four New Process pinions made by the New Process Raw Hide Company of Syracuse, N. Y., were substituted for the four steel pinions. These rawhide pinions were put into service over two years ago, and there has not been a moment's trouble with the gearing since. In fact, the pump has been out of service only long enough to repack the plungers and replace the rubber valves. Rawhide, where properly cured and machined, makes up into a gear or pinion that is much the same as metal, except that it has no metallic ring and is more elastic. This elasticity is highly advantageous on motor and other drives in that it absorbs the shock as large gear teeth come into contact and as cutting tools come into cutting contact, and it cushions the irregularity of load due to the reciprocating movement of parts in machine tools or geared power plant apparatus."

MR. W. S. ROGERS, President of the Bantam Anti-Friction Company, is now on his annual pilgrimage in Germany, visiting with his allied companies there in the manufacture of steel balls and ball bearings, and arranging for the coming year's contracts. He expects to meet the mechanical engineers, who sail in July, upon their arrival in Manchester, England, to attend the joint meetings with the Institute of Mechanical Engineers of Great Britain.

"NO ONE DOUBTS the good steaming qualities of Stirling boilers, but in removing the scale from their tubes it has been necessary to have a man crawl into the drum, sit cramped up in an uncomfortable position, and run a turbine cleaner through each tube. It was also necessary to have a helper on the outside to turn the water or steam on or off. All this discomfort and inefficiency in cleaning this type of boiler has been rendered unnecessary by a new device recently perfected by the Lagonda Manufacturing Company, Springfield, Ohio. The device consists of a sectional trough arrangement having a funnel at the far end for guiding the turbine into the tube. The trough is supported on the edge of the manhole at one end and by a special tripod over the tubes at the other end. This tripod can be easily moved around at will, thus allowing the cleaner to be shifted from one tube to another. The operator places the funnel over any tube he wishes to clean and starts to feed the cleaner in, the rate of feeding being determined by the amount and character of the scale. In feeding in the cleaner the operator is guided entirely by the ear and touch, but he would have to be guided this way, anyhow, even if he were on the inside, as on account of the curvature it is impossible to see through Stirling boiler tubes. After cleaning one tube the tripod is shifted to the next one, and the cleaner fed in as before. It should be noted that when the supply hose is filled with water it becomes rigid enough to force the cleaner at any desired rate. As a trough arrangement is made up of short lengths which snap together, the device can be used in very cramped quarters. There are no obstructions or guides on top of the trough, and the cleaner and hose can any time be withdrawn from the drum and the cutter wheels renewed or the turbine inspected. It has been found that by using this device the time consumed in cleaning Stirling boilers is greatly reduced and the cost of helper is eliminated. It also guarantees a first-class job to the owner."

THE ALBERGER CONDONSER COMPANY and the Alberger Pump Company have removed their offices to the West Street Building, 140 Cedar street, New York.

CEIBA, HONDURAS, C. A.—Dr. Virgil C. Reynolds, of Ceiba, has purchased a six-cylinder, 54-horsepower heavy-duty Buffalo, made by the Buffalo Gasolene Motor Company, 1209 Niagara street, Buffalo, N. Y., for his new 50-foot cruiser.

A GREAT INJECTOR BUSINESS.—The Penberthy Injector Company, Detroit, Mich., states that on March 29 the company numbered its six hundred thousandth Penberthy automatic injector, and that this is by far the largest number of injectors manufactured by any one concern in the world.

THE 1911 NATIONAL MOTOR BOAT SHOW will be held in Madison Square Garden, New York City, from Feb. 21 to March 4. A slight change in the rate per square foot has been made, which the committee hopes will enable more to exhibit boats than has been the custom in the past. Additional space will be available so that all can be accommodated. Full information can be obtained by addressing the manager, Capt. J. A. H. Dressel, 29 West Thirty-ninth street.

MARINE STEEL CASTINGS.—The Bayonne Steel Castings Company, with main office at 30 Church street, New York, has purchased property at Bayonne, N. J., and will immediately erect a large plant especially for supplying steel castings to shipbuilding and dry-dock concerns. The company expects to turn out from 400 to 500 tons per month. The main foundry building will have 30,000 square feet of floor space, and as the site for the plant comprises five acres, plenty of space is left for expansion. The company hopes to have the plant in full operation early in August.

A VALUABLE MARINE GLUE.—L. W. Ferdinand & Co., 201 South street, Boston, Mass., have just received the following letter regarding their Jeffrey's marine glue: "I am in receipt of your circulars of May 9 in regard to Jeffrey's marine glue. I wish to say that I have been master of the schooner yacht *Latona* since she was built in Lawley's in 1899, and can testify to the merits of this glue, which I have always used on *Latona* and other yachts that I have had previous to her. I consider it, if properly handled, the best material for deck seams. Very truly yours, H. T. Smith, Auxiliary Schooner Yacht *Latona*."

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.
Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Young man of 30, connected with the technical staff of various shipbuilding companies for the past ten years, desires to receive proposition to act as general agent or as Southern representative for marine specialties, or would consider any Atlantic Coast territory. Address *H. B. H.*, care INTERNATIONAL MARINE ENGINEERING.

Professor of Naval Architecture.—A professor of naval architecture (not including machinery) will be appointed at the Technical High School, Trondhjem, Norway. Salary commencing at kr. 4,500 (about £250) per annum, increasing kr. 500 after five, ten and fifteen years to kr. 6,000 (about £333). If an applicant requires one or more of the additional sums from the first, and such demand appears sufficiently warranted, the government might apply to the Storting for the increase. The appointment will be made immediately after the expiration of the term within which applications are received, but the professor appointed will not enter on his duties or commence drawing the salary of the office until further determined by the government department concerned, as the instruction will not be needed during the first school year. Until his induction, the professor must be willing to assist in working out plans for courses of study and other preparatory work against separate remuneration. If, on entering on his office, instruction should not be at once required to be given to the normal extent in the subjects pertaining to his professorship, the professor may be required temporarily to take over other allied subjects to such extent as would correspond with a professor's ordinary duties, and which may amount to not exceeding eight or ten lectures weekly. The professor must contribute to the widows' fund, and possibly to a pension fund, and he must submit, without claim to compensation, to such alterations in the duties of his office as may be enacted by law or by the King, with consent of the Storting. Applications giving full particulars respecting the applicant's training and subsequent employment and salary required, and stating when he could enter upon duties, together with copies of testimonials, should be addressed to the King, and be sent to the Kongelig Kirke, og Undervisningsdepartment, Kristiania, by or before July 31.

BUSINESS NOTES

GREAT BRITAIN

MATTHEW KEENAN & COMPANY, LTD., have recently secured the contract from His Majesty's Office of Works to cover the whole of the boilers, calorifiers, steam pipes, etc., at the new G. P. O. King Edward VII. building, Newgate street, with their non-conducting composition. It is gratifying to learn that this firm are working practically night and day on the orders they have in hand at both their London and Glasgow works.

THE STONE-LLOYD SYSTEM for watertight bulkhead doors has, we understand, been installed in the large trans-Atlantic steamer *La France* and in the new Dreadnought battleship now being built at Yokosuka for the Japanese navy. This latter vessel has twenty-two doors. In adopting the Stone-Lloyd system the Japanese naval authorities show, again, their acumen in selecting the most modern and serviceable improvements in ship construction. Hydraulic power, it is contended by J. Stone & Company, can alone be relied upon to work satisfactorily in the damp and dirt of stokeholds, that steam is dangerous, and electricity liable to fail at the critical moment, and dangerous where there is a possibility of fire-damp.

THE BERGIUS LAUNCH & ENGINE COMPANY'S new works in Dobbie's Loan, Glasgow, were recently completed. The works are built on the site of the once-famous engine shops of Messrs. Robert Laidlaw & Sons, and are constructed on up-to-date lines, the roof being of the weaving shed type, with north light only. The shop measures about 250 feet by 100 feet under one roof without divisions. The floor is of concrete, and the ventilation and lighting are all that could be desired. The old works of the Bergius Company are now historical, having been the birthplace of two other motor firms—the Albion Motor Car Company and Messrs. Halley's Industrial Motors. The company are securing an excellent and growing reputation with their "Kelvin" engine.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
First Vice-President—Art Hyde, 9115 Willard Ave., N. W., Cleveland, Ohio.
Second Vice-President—Wm. P. Tindall, 180 Twentieth St., Detroit, Mich.
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Secretary—Geo. A. Grubb, 1040 Dakin St., Chicago, Ill.
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John A. Watts, 318 Fifth St., S. E., Washington, D. C.

COVERING FOR SHIPS' HULLS.—A provisional patent has been obtained by Mr. Bernard A. Kupferberg and Captain Neilson for a method of preventing the fouling of the hulls of ships, particularly in tropical waters, by covering the hulls with sheets of glass. The glass is applied to the bare metal in pieces about 6 in. square, and is fastened by a layer of a special adhesive substance formed of wood pulp, resin and linseed oil. This layer is about ⅛ in. in thickness, and besides fixing the glas, compensates for the difference between the co-efficients of expansion of the metal and the glass. It is claimed that it is impossible for foul growths to obtain a hold on the hull of a vessel which is treated in this manner, and that the necessity of painting is entirely obviated. Even when the glass is cracked with a hammer it appears to remain firmly adherent to the metal plate.

LARGE CRANE.—The electric crane which Sir William Arrol & Company are now erecting at the Fairfield Shipbuilding & Engineering Company's yard on the Clyde will be the most powerful hammer-head crane in Great Britain. It is designed to lift 200 tons at 75 feet, or 40 tons at 162 feet, radius. The length of the jib from the center of the tower is 168 feet, or including the counterpoise a total of 266 feet. Over 1,000 tons of steel will be utilized in the construction. The tower consists of four built-up columns braced together and placed at the corners of a 45-foot square, tapering to 40 feet square at the roller path. The height of the tower is 140 feet above quay level. The foundations for the columns have been taken down to 60 feet below that point, and have been sunk with the aid of compressed air. It is expected that the work will occupy another six months. On completion the crane will be required to undergo tests 20 percent in excess of the specified working loads.

TRADE PUBLICATIONS.

AMERICA

Coal handling and hoisting machinery is the subject of Catalogue No. 102, just published by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y.

Victor regulators for controlling temperatures and pressures are described in a catalogue published by the Standard Regulator Company, 90 West street, New York City.

A portable electric breast drill has been placed on the market by the General Electric Company, Schenectady, N. Y., the value of which, the manufacturer states, is most appreciated in places where other drills are hard to handle, and that, in contrast to a pneumatic drill, there are no air holes to leak or kink and no valves to get out of order. This tool has been designed for and adopted with profit by shipyards, machine shops, boiler works, locomotive works, tool makers, etc.

The Mitsu-Bishi Dockyard & Engine Works, Nagasaki and Kobe, Japan, have issued a handsomely illustrated pamphlet describing their shipbuilding and engineering works and docks. The models of these works and docks are shown at the Japan-British exhibition in pavilion No. 47, and also a model of the turbine steamer *Chiyo Maru,* built by them for the Toyo Kaisen Kaisha. This is the largest vessel built in Japan. The gross tonnage is 14,000, with a speed of 21 knots.

Every engineer should send for a copy of Catalogue 18-L, published by the L. S. Starrett Company, Athol, Mass. This is an extremely complete and profusely illustrated volume of 232 pages, which will be sent free to any of our readers who mention INTERNATIONAL MARINE ENGINEERING. Measuring tools and instruments of precision of every kind are described in this catalogue, such as micrometers, gages, squares, measuring tapes, calipers, dividers, etc.

Gas analysis instruments and allied specialties are the subject of the catalogue issued by the Carb-Ox Company, Rogers Park, Chicago, Ill. This concern does not make laboratory apparatus, and all of its instruments are portable. The company states that its apparatus enables the power producer to work out the highest possible economies in the use of fuel, irrespective of what the fuel may be, whether coal, oil, gas or refuse.

Pump Catalogue No. 46, published by the De Laval Steam Turbine Company, Trenton, N. J., states that 25,000 boiler horsepower is the capacity of one of its steam turbine-driven boiler feed pumps, which can be governed by any ordinary pump governor, and which, it is stated, will maintain a uniform pressure, or constant excess of pressure, in the feed line, as desired. The statement is made that it does not give rise to shock or pulsation, that it has no valves to get out of order and no plunger or piston packings to leak.

Twinvolute turbine pumps are described in Catalogue No. 75, published by the Watson-Stillman Company, 188 Fulton street, New York. One of these tandem outfits is handling 11,000,000 gallons of circulating water per day in a large condensing system, and the Watson-Stillman Company calls attention to the installation as an evidence of the adaptability of Twinvolute pumps to any volume, any pressure and any service. These pumps have been very successful for boiler feeding, circulating condenser water, supplying tanks, fire service and other marine uses.

The engineers' catalogue, published by the New York Belting & Packing Company, 91 Chambers street, New York City, is a complete packing catalogue meeting the needs of every engine room, and a free copy will be sent to any of our readers upon application. "In the revised engineers' catalogue which we lay before you, we can hardly give you an adequate idea of the almost unlimited styles of high-grade packings which we manufacture. We have endeavored to illustrate and describe the most important. Since 1846 we have been manufacturers of this class of goods, employing the best skilled workmen, using the most modern machinery and highest grade materials which enter into their construction. This permits us to give a full guarantee of the superiority of our packings. Through our long experience as manufacturers, with the valuable patents which we own and control, together with the scientific methods we have of testing our packings for resiliency, density, frictional resistance and heat-resisting qualities, we have won our reputation as high-grade manufacturers and the confidence of our customers. The equally important subject of special heat-resisting lubricants has not been overlooked, for we fully realize its importance. High-grade packings have often proven dismal failures owing to poor lubrication. No one packing is suitable for all conditions. You should advise us of the work required and we will furnish you with the packing best suited to meet these conditions."

An interesting booklet of 48 pages, entitled *Battery Charging Rheostats,* has been published by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The booklet describes this company's entire line of battery-charging rheostats, comprising two types for charging ignition batteries and six types for general charging work for electric pleasure vehicles and for trucks. Full-page illustrations of the various types are shown, besides several special types, such as a motor-generator set panel and a panel for use with a gas engine-driven dynamo and storage battery. One section of the booklet is devoted to descriptions and illustrations of protective panels and devices. The application and advantages of the low-current cut-out, maximum voltage cut-out, solenoid switch and overload circuit breaker arrangements are pointed out. These devices prevent overcharging and protect the batteries against damage, due to abnormal current conditions. The method of tabulating the electrical data and the list prices is worthy of comment, all information being condensed into a single table. This publication (copies of which can be obtained on request) should prove of value to all interested in battery charging.

A handy little pamphlet has recently been issued by the Morse Twist Drill & Machine Company, New Bedford, Mass., known as the *Young Machinist's Practical Guide.* The book contains useful information regarding the ordering, grinding and use of twist drills, reamers, tap drills, tap threads, milling cutters, etc. Other things being equal, a man's ability as a machinist can be estimated roughly by the knowledge he displays in handling twist drills. To properly grind a twist drill requires careful study and considerable practice. Few operations on tools in the shop are more frequently disappointing than the grinding or sharpening of drills. This pamphlet gives complete information regarding the grinding of twist drills, together with sketches showing the manner in which the work should be done. A useful table is also given, showing the speed of drills from 1/16 to 2 inches diameter when working in wrought iron and steel, cast iron and brass. Tables of the decimal equivalents of nominal sizes of drills are also given. Valuable suggestions for ordering reamers, sharpening reamers, and suggestions for ordering cutters are set forth, together with illustrations of standard reamers. Another useful table is that showing the cutting speeds of various sizes of milling cutters. The book also contains useful tables of weights of square and round bars of wrought iron, the weights of iron and steel sheets and the proper lubricants for cutting tools, and finally definitions are given of increased twist and constant angle—two terms which are frequently misunderstood even by good machinists.

TRADE PUBLICATIONS

GREAT BRITAIN

J. W. Brooke & Company, Ltd., Lowestoft, are publishing a book of testimonials from users of their motors and boats. These letters come from all parts of the world, and attest the great popularity of this firm's output.

J. Archdale & Company, Ltd., Ledsam street, Birmingham, have issued a well-printed and illustrated catalogue, which gives full particulars of their radial drills from 2 feet 6 inches to 7 feet radius. Some improvements of special merit are included. Some of the machines which are illustrated have a change-speed box giving eighteen different speeds; these can be instantly changed by the simple movement of a lever. The power from the change-speed box is transmitted to the top shaft by a silent chain drive. Combined sensitive and radial drilling machines are also described and illustrated in the list.

The Linde British Refrigerating Company, Ltd., 35 Queen Victoria street, London, E. C., have published an excellent catalogue of their specialties, under the title of *Ice-Making and Refrigerating Machinery on the Linde System.* The Linde and Lightfoot well-known system of ice-making and refrigerating machines, which were introduced into Great Britain and other countries by Mr. T. B. Lightfoot, the managing director of the company, who was, we understand, the pioneer in refrigerating machinery in this country. The catalogue shows the various types of machine, the ammonia system, the carbonic acid system, marine machines on the ammonia system and on the carbonic acid system, ice-making plants and cold dry-air machines on the "Lightfoot" system. A good many excellent illustrations are included. A list of the leading shipping companies who have adopted the system is given. We see that not only the British government but the principal foreign governments utilize the Linde system. Seven thousand six hundred installations have been made, and these have a capacity equal to 180,000 tons of ice melted every day.

Machine tools are the subject of a profusely illustrated catalogue issued by Perkin & Company, Ltd., Lord Street Works, Leeds. In issuing this catalogue the firm draws attention to many new tools included for the first time, and to the general reduction in prices made.

Motors and dynamos are the subject of a catalogue published by J. H. Holmes & Company, Newcastle-on-Tyne. In compiling this catalogue of continuous-current motors and dynamos, especial attention has been given to the arrangement of the particulars in order that the outputs, prices, etc., may be ascertained without difficulty.

J. Beardshaw & Son, Ltd., Baltic Steel Works, Sheffield, have just published the third edition of a pamphlet entitled *Notes on High-Speed Steel, Saws, Drills, Etc.* Since the last edition of this pamphlet was issued several improvements have been effected in the treatment of the various tools of the above firm's "Conqueror" brand, which are said to be the result of scientific heat treatment research.

The Rivet, Bolt & Nut Company, Ltd., 74 York street, Glasgow, have issued a catalogue dealing with their manufactures. The list contains approximate weights of bolts, nuts, rivets and bars, particulars of British standard and other tests, hints on heating rivets, standard dimensions and other useful information. There are, of course, prices and illustrations. The list is a handy book of reference.

Drummond Bros., Ltd., Ryde's Hill, near Guildford, supplied a lathe to Capt. Scott's expedition to the South Pole. The tool is one of the firm's well-known 3½-inch center screw-cutting, motor-repairing lathes; it has been fitted, at the request of the expedition, with similar accessories to those recently supplied on a lathe to H. M. S. *Swift*. Motors are being taken by the Scott expedition, and the tool ought, therefore, prove of great assistance in many ways.

BUSINESS NOTES

AMERICA

The Lagonda Manufacturing Company, Springfield, Ohio, announces that the demand for its Weinland boiler tube cleaners has been so great that it has been forced to increase the size of its plant. The company has accordingly added a new wing very nearly as large as half of the former plant. This new building is of concrete construction, with slate roof, well lighted and ventilated. The stock and tool rooms have been removed from the old plant into the new edition, and the space formerly occupied by these departments equipped with new automatic machine tools, which will enable the company to meet the increased demand for its products and to give prompt deliveries. The Lagonda Manufacturing Company reports that it has for the last six months been running night and day in order to keep up with orders.

Satisfactory shipboard service of the G-E bake oven is reported by the General Electric Company, Schenectady, N. Y., which writes International Marine Engineering that "the following extracts, from reports on ovens in service aboard ship, is convincing evidence that the actual use of the G-E electric oven substantiates the claims to superiority over the old-style coal-heated oven: 'From every point of view electric cooking appliances are more suitable for ship purposes than the old fashioned coal-burning appliances.' 'Thorough test for several weeks under severe conditions has been found most satisfactory in comparison with the coal-burning oven.' 'All products baked in it are far superior in every way to the same products baked in a coal-burning oven.' 'Baking process requires much less time and attention.' 'The adoption and use of the electric bake oven is strongly recommended.' 'In consideration of the fact that ship-bread baking is an intermittent rather than a continual performance, and that oven fires are lighted and allowed to die out daily, the electric bake oven easily establishes its superiority for economy of performance.' 'The further consideration of cleanliness, elimination of galley coal boxes, draft troubles, soot accumulation, broken firebrick, etc., all tend to support claims of the electric oven. The general adoption for use on shipboard is strongly recommended.' 'The quality of bread is much better, being baked more uniformly, more quickly, requires less attention to keep from burning and requires only one shift.' Your investigation of this important subject is invited. Write us freely. *Electric Cooking*, an illustrated pamphlet describing apparatus for galley or restaurant use, will be sent free to all interested. When you write ask for Publication 3,968."

THE PHILADELPHIA LUBRICATOR & MANUFACTURING COMPANY has sold its United States patents, manufacturing plant, etc., to the Universal Lubricator Company, the Bourse, Philadelphia, Pa. The latter company announces that it is moving its plant to larger quarters at American and Diamond streets, Philadelphia, and increasing its manufacturing facilities by the installation of additional machinery, so that it is now in shape to supply "Philadelphia" compressed air grease cups promptly in large quantities.

TERRY TURBINES IN ENGLAND.—The Terry Steam Turbine Company, 90 West street, New York, has been awarded the contract for building three torpedo type vertical turbines with direct-connected fan by Yarrow & Company, Ltd., Glasgow, for use on the two destroyers that the latter firm will build for the British Admiralty. There are to be four sets on each destroyer. Yarrow & Company will build the remaining five sets at their yard from drawings of the Terry Steam Turbine Company, which states that these vertical units are practically duplicates of those which the company is furnishing on all of the latest American-built destroyers.

SATISFACTORY ALMY BOILERS.—The steel yacht *Aquilo*, built in 1900, 152 feet over all, 125 feet on waterline, 20 feet beam and 9 feet 3 inches draft, arrived in Seattle recently from New York, after a voyage of eighty-nine days, twenty-seven of which were lay days. Capt. H. H. Williams, who brought the yacht around, reports that she averaged 10 knots on the trip, and gave general satisfaction throughout. The engines are of the triple-expansion type, 10¾-17 inches and 27 by 18 inches stroke. The boilers consist of two Almy watertube boilers, having a grate surface of 53.6 square feet and a heating surface of 2,308 square feet. The chief engineer, Hugo Nygren, stated that he had no trouble whatever with the boilers or engines, and could have made the return trip without repairs or overhauling. He is enthusiastic in his praise of the Almy watertube boiler, and reports that on the voyage from New York he had no trouble therewith, even in the roughest weather. He further reports that having had experience with the Almy boiler, he left New York without carrying any extra sections, knowing that they would not be required.

POINTS IN REGARD TO APPLYING MARINE GLUE TO SEAMS OF DECKS.—"Do not attempt to heat all the marine glue you expect to use at once. Heat only what is necessary for immediate use, and as it is half used out of the kettle add fresh glue, keeping it stirred now and then. It should be used as soon as it is melted and not allowed to stand in the kettle. Continued boiling hardens and injures the glue. Almost without exception unsatisfactory results in using this material are occasioned by faulty application and are produced entirely by two causes: First, if either the oakum or cotton calking or the seam is damp when the glue is applied, as soon as the sun shines on the deck the heat will turn this moisture into steam, which will force the glue up over the edge of the seam. Second, in paying the seam the ladle should be held at least an inch above the deck. If the ladle is drawn on or close to the seam a quantity of atmosphere will envelop, and has no time to escape before the glue becomes set. This will cause air bubbles, which in hot weather will also force the glue up over the edge of the seam, leaving it hollow and unsound. The seams must be absolutely dry and clean before the glue is run into them. If applied to old work the old material should be dug out perfectly clean. Whatever adheres to the sides of the seam should be removed with a rase knife. Full directions for the proper use of this material will be furnished free of charge by L. W. Ferdinand & Company, 201 South street, Boston, Mass., U. S. A."

A handsome gunmetal watch fob will be sent free to any of our readers who will mention this magazine by the E. M. Dart Manufacturing Company, Providence, R. I.

Ray D. Lillibridge, Inc., advertising managers, have moved from 100 Broadway to larger offices at 192 Broadway, in the Chatham National Bank building, New York.

Installations of Welin Davits.—During the last few years the Welin quadrant davit, made by Welin Davit and Lane & De Groot Company, 17 Battery Place, New York, has become deservedly popular all over the world. During the past year the following ships, built and under construction in the United States, were equipped with these davits: The *Wilhelmina,* Matson Navigation Company; the *J. A. Chanslor,* Associated Oil Company; the *Ancon* and *Christobal,* Isthmian Canal Commission; the *Bear* and the *Beaver,* San Francisco & Portland Steamship Company; the *Alabama,* Goodrich Transit Company; the *Honolulian,* American-Hawaiian Steamship Company; the tug *Daniel Webster,* Erie Railroad Company; the tug *Fulton,* Delaware, Lackawanna & Western Railroad Company; harbor tugs, *Gen. George H. Weeks, Gen. S. B. Holabird, Gen. D. S. Stanley,* United States government; the *Seminole,* Southern-Pacific Company; *Navajo,* Southern-Pacific Company; *Ensinal,* Southern-Pacific Company; *Melrose,* Southern-Pacific Company; *Rikers Island,* New York City, Department of Public Charities; yacht *Aloha,* Mr. Curtis James; ferryboat, Newburgh Ferry Company. In Europe, where the davits were introduced prior to their coming to the United States, they are specified for practically all new construction of any importance, and it is a pertinent fact that when a line has once installed a pair of these davits on one of their ships they are invariably called for in all new construction. The Welin davits are found on the ships of every European nation and on the modern Japanese liners—which show that the Japanese know a good thing when they see it. Among the most important installations made in Europe recently are the equipments on the following vessels: The *George Washington,* belonging to the Bermer Lloyd; the *Gastein* and *Stambul,* of the Austrian-Lloyd; four new steamers for the Union Castle Mail Steamship Company; the *F. S. Deutschland* and *F. SS. Preussen,* belonging to the German government; the *Vollrath Tham,* of the Lulea Ofoten Company; the *Drottning Victoria,* the big ferry of the Swedish government.

Attention is called to the advertisement in this issue of International Marine Engineering of the Charles Ward Engineering Works, Charleston, W. Va., which has on hand for immediate delivery one pair of engines 9"-15¼"-25⅝" x 18". Also 7½"-12½"-20" x 12".

The B. F. Sturtevant Company, Hyde Park, Mass., the large manufacturers of fans, blowers, fuel economizers and mechanical draft apparatus, are so well known to everybody in the manufacturing line and their salesmen are known personally to so many architects and engineers, that it is a matter of interest to note their Salesmen's Convention, held June 15 to 18. The branch office managers and principal salesmen from all over the country assembled at the works and general offices at Hyde Park and spent four very busy days in going over general business matters. Their evenings were enlivened by banquests and other social features. The last day of the convention closed by a delightful sail down the harbor and an afternoon and evening as the guests at the Cohasset home of Mr. E. N. Foss, treasurer of the company. The convention was marked by great enthusiasm, as the company has just finished, July 1, the largest business year in its history.

"A fertile source of fire in manufacturing, power and similar industrial establishments is oil—not illuminating oil but that used for lubricating purposes. The impossibility of absolutely confining oil within any but the most exquisitely ground type of bearing results in a goodly amount of oil dripping or splashing out of the bearing and onto the floor. If the latter is of concrete, the oil saturates it, thereby weakening the mass and making the floor unsafe. If the floor is of wood, the dripping oil renders it highly inflammable. Only a spark is needed to start combustion. That fire insurance companies recognize this fact is evidenced by the higher rate charged on buildings containing oil-lubricated machinery than on buildings housing machinery lubricated with plastic lubricants, grease, for instance. The ability of grease to stay where it is put, to use an apt phrase employed by Adam Cook's Sons, manufacturers of Albany grease, prevents either splashing or dripping of the lubricant. Consequently, the fire risk is considerably decreased, to say nothing of the considerably increased cleanliness secured. One of the reasons for the widespread use of Albany grease is the recognition by thoughtful engineers of the freedom from fire risk that its use insures."

MR. GEORGE B. FOSTER has been appointed Chicago sales manager of the Wisconsin Engine Company, Corliss, Wis. His offices will be located in the Fisher building.

THE FALLS HOLLOW STAYBOLT COMPANY, Cuyahoga Falls, Ohio, has appointed Mr. H. W. Davis, No. 2 Rector street, New York, as its Eastern representative.

THE FLANNERY BOLT COMPANY, Frick building, Pittsburg, Pa., manufacturers of Tate flexible stay-bolts, announces that its factory has shipped at the rate of 5,000 bolts per day since the first of the year.

"HAVE YOU A BROKEN PIECE OF MACHINERY?" is the question asked by the Oxy-Carbi Company, 516 Orchard street, New Haven, Conn. This concern does "oxy-acetylene welding in soft steel, semi-steel, cast iron, copper, brass, aluminum, bronze, etc. We rectify errors in pattern making, alter castings with the same metal for refinishing; add on stock to any piece in any shape. Broken engine cylinders, I-beams, axles, automobile frames, teeth in gears and sprockets, expensive machine parts of all descriptions, metal statuary, water backs, boilers, etc., repaired. There is a wide range in repair and new work."

"ENGINEERS UNDERSTAND THE DIFFICULTY, and oftentimes the danger, there is in connecting the indicator to standard on crosshead, especially where an inexperienced engineer attempts to connect up on a high-speed engine. Not only is there risk for the engineer, but there is danger that the indicator may be wrecked. Numerous devices have been designed in the past, so as to render the making of this connection easy. These, while they have been more or less successful, have always been cumbersome and expensive. A new device for the purpose has just been made by the Trill Indicator Company, Corry, Pa., in this line. This is at once the simplest and most efficient, and renders the operation of connecting to standard on crosshead a very simple matter, even though the engine may be running at 400 or 500 revolutions per minute. Its operation is the very simplest. Hold the loop of hook between thumb and finger, allowing the pin on standard to strike the straight part of hook when it is within about 1 inch of the end of its travel, and connection is made instantly without danger to instrument or operator."

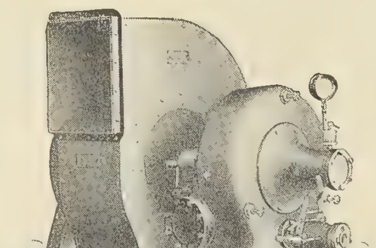
BUSINESS NOTES

GREAT BRITAIN

DAVID BRIDGE & COMPANY, LTD., Castleton, Manchester, have extended their works by the addition of two bays, each 45 feet by 200 feet long, in order to carry out work in connection with their Heywood and Bridge's improved patent friction clutches, mill gearing, haulage plants, rubber, gutta-percha and balata machinery, etc.

NEW PATTERNMAKING SHOPS.—David Brown & Sons, Ltd., of Huddersfield, are transferring their East Parade Pattern Works to Lockwood, where new shops, covering an area of 14,000 square feet, are being erected alongside their foundry and gear works. These new premises will be replete with all the latest woodworking machinery, extensive stores, drying sheds, stoves and timber yard. We learn they are very busy on all classes of work, from motor patterns to large marine turbines.

A NEW TYPE OF STEAM REGULATOR VALVE.—"The mechanical effort required to open some designs of steam-regulating valves is at times excessive, and has led to frequent attempts to introduce devices whereby it may be minimized. This is especially so in the case of locomotives, where it has long been customary to supplement the main throttle valve with a small pilot valve, or to use valves of the double-beat type. These, while largely helping in the desired direction, are liable to further troubles and are more expensive to manufacture. A valve which it is claimed satisfactorily overcomes these difficulties, while possessing many other advantages, has recently been designed and patented, and is now being constructed in this country by the Hulburd Engineering Company, Ltd., of London. This valve has been given the name of the 'Servo,' and has been designed for use in all cases in which the supply of steam has to be controlled. In particular it is designed for locomotive work, and we understand about 1,000 engines have up to the present been fitted with it, including some belonging to one of the leading railways of this country, and to those of important Continental and American railways. It has also been installed on board several steamships, among which, we believe, are some cruisers belonging to a foreign Power. In addition, its use on winding and hauling engines, and many other types of steam engines, is said to be attended with good results."



HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Whitehead & Company, Fiume, Hungary, have obtained the order for building a second submarine boat of the Whitehead type for the Dutch government.

The invention of an entirely new system of submarine and wireless telegraphy has been announced by Mr. Hans Knudsen, a Danish inventor. The claim is made that this invention is applicable to existing lines and wireless systems without, in the former case, affecting wires, and that the invention quadruples speed at which messages may be sent to any part of the world, and that, by augmenting the present capacity of cables, it will make it possible to send messages to any part of the world at one-third the present rates. Particulars can be obtained by addressing H. Matthews, Esq., 15 Essex street, Strand, London.

Apropos of the deaths from asphyxiation which occurred recently on board the Great Central Railway Company's steamer *Ashton*, a correspondent writes pointing out that an improved form of ventilation would in all human probability have prevented such a tragedy. In the case in question the ventilators, it seems, had been removed and the openings in the deck covered up, doubtless to stop the water from obtaining entrance in bad weather. Our correspondent cites, in support of his contention, the weather-proof ventilators manufactured by Messrs. John Gibbs & Son, of Liverpool, which, as their name implies, need never be removed, covered over or trimmed, no mattr how bad the weather may be. In Messrs. Gibbs' system an extractor removes the vitiated atmosphere from the hold or compartment of the ship to which it is applied, while the "downcast" affords a supply of fresh air to replace that removed by the extractor, so that the action is both continuous and automatic. Another advantage, particularly in the case of passenger vessels, is that it is impossible to introduce matches, cigar ends, or other dangerous matter through these ventilators.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
207 Bath Street, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

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Second Vice-President—Wm. P. Tindall, 180 Twentieth St., Detroit, Mich.
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TRADE PUBLICATIONS.

AMERICA

Marine hardware is described and illustrated in a catalogue of 440 pages published by A. S. Morss Company, 210 Commercial street, Boston, Mass., and containing nearly 2,000 illustrations. To the former edition of this catalogue have been added 100 pages containing all the new yachting and motor boat specialties, and including a full line of Morss electrical specialties. The company's special feature of classifying goods makes this catalogue an unusually valuable one. It will be sent free to readers of INTERNATIONAL MARINE ENGINEERING upon receipt of 6 cents in stamps to pay for the cost of mailing.

Steam power equipments are the subject of a handsomely-printed catalogue published by the Seattle-Talbot Generator Company, Seattle, Wash. "Some years ago a small company was incorporated; and the stock subscribed for among a few well-known and friendly business men known as the Seattle-Talbot Generator Company, for the purpose of developing Mr. Talbot's invention in the form of a new type of steam boiler. Extensive experiments were conducted quietly in the company's shops for several years, and after these experiments were made numerous tests of the boiler followed, which were even more startling than were expected at first. A launch was built and equipped with a steam engine, pumps of the usual form used on small launches, and a small boiler placed in this launch to operate this machinery. When tested on the feet of heating surface (the usual way of rating boilers) the boiler was found to verify the shop tests and to be capable of operating an engine which would ordinarily be six times its capacity. This launch has been run in a successful manner for some time, and has been of interest to a great many during this time, who witnessed it steaming with little or no noise and demonstrating considerable power. The space which is available aside from the machinery is considered by engineers as being remarkable, as the drawback heretofore with steam launches has been that the space occupied by the boiler was so great that little space was left for accommodation. The space occupied by machinery in this launch (the *S. T. G.*) is about the same as the space occupied by a heavy-duty gasoline engine of the same power, but the steam outfit weighs only one-half as much as the gasoline engine having the same horsepower. This new form of boiler does away with the smoke, and when in operation no dirt of any sort passes from it. There are no ashes or refuse and the fuel used is common crude petroleum, which, combined with the great efficiency of this new boiler, makes the cost of operation extremely low."

A price list of wire rope and wire rope fittings has just been issued by the Durable Wire Rope Company, 93 Pearl street, Boston, Mass. "Durable wire rope is what its name imports—a rope which will endure hard conditions of use and outwear ordinary rope. This is due to a type of construction, peculiar to Durable rope, which enables it to combine the good qualities of both wire and hemp rope—the strength of wire, with the flexibility, freedom from rust and friction of hemp. Wire ropes in general contain a hemp center, and it is universally admitted that this center tends to prolong the service of the rope. It is clear that with a number of strands of wire twisted together about a common center, if that center also is wire, there will be friction with resulting wear between the center and the other strands as these strands adjust themselves to the stress. This a hemp center prevents; but it does not prevent in a wire rope, as ordinarily made, the friction between the remaining strands; the grinding of steel upon steel which is so destructive to the life of a wire rope frequently used. This friction is effectually prevented in a Durable Wire Rope by the very simple process of continuing the protective principle of the hemp center throughout the rope. This is done by separately covering each wire strand with a specially prepared hemp marline, so that the finished rope contains the wire strands and the hemp center, with all the strands protected against friction at the common center, and also equally well protected aainst friction between the individual strands. Not only does the Durable method of rope construction prevent the destructive effect of friction, but it also protects the wires from the percolation of moisture and acid fumes between them. The result of this, as many familiar with the service given by both ropes will testify, is the preservation of the life and strength of the wires in a Durable rope, long after ordinary wire rope is rusting upon the scrap heap. The wires in Durable rope are drawn from the best grades of crucible steel, extra strong crucible steel and plow steel, thus making it adaptable for many purposes.

"How to Reduce the Expense of Selling Machinery" is the title of a pamphlet in which the George H. Gibson Company, Tribune building, New York, describes improved methods for promoting the sale of machinery by means of educational work and advertising. Beginning with the statement that advertising is an expression of the spirit which animates a business and properly begins at home, the importance of informing and enlisting the enthusiasm of a firm's own people—the salesmen and agents—by means of bulletins, salesmen's handbooks, conferences, etc., is first taken up. The pamphlet then proceeds to discuss the several kinds of advertising literature intended to arouse the interest of consulting engineers, owners and operating engineers, and the channels through which such literature may be distributed, as by mailing lists, through personal work of salesmen, and by advertising in periodicals. Hints are given concerning the writing of circulars, catalogues and advertisements, of treatises and text books, and of descriptive articles for the technical papers, that will be suggestive to anyone who is responsible for the sales promotion of products of an engineering or mechanical nature. Valuable tables and charts are also given showing the mailing weights of pamphlets and the relation between technical journal circulations and the price of advertising space.

Automatic buoys and beacons are described and illustrated in a handsome catalogue published by the International Marine Signal Company, Ottawa, Can. The Commissioner of Marine Lights of the Dominion of Canada in his annual report for 1905 states, speaking of this company's buoys: "The great increase in the light power of the automatic buoys, due to the use of acetylene and the gas lanterns employed, makes them in reality floating lighthouses, and of an order superior to many of the lighthouses in Canada." Captain Rodgers, inspector of the Third Lighthouse District of the United States, states regarding the same buoys: "Owing to the great size, weight and high focal plane of these two aids to navigators, they may properly be called floating lighthouses, attended by tenders instead of by regularly appointed keepers." The catalogue states: "The lighting medium under our system is acetylene gas from which all impurities have been removed by the use of a special purifier manufactured by ourselves. The buoys are automatic in operation. They generate their own gas, under low pressure, and with one full charge of calcium carbide, which varies from 1,300 to 3,500 pounds, according to the size of the buoy, give a continuous light without diminution of power, for about six to nine months, during which time they require no attention. The lantern used is the best buoy type, equipped with a Fresnel lens, which condenses the light into an intensely powerful and penetrating, horizontal beam. It is generally recognized that acetylene gas gives greater candle power per cubic foot than any other gas, but the precise degree of increased strength perhaps may not be so well known. The fact is that the candle power of acetylene is seven times greater than that of oil gas used in a state of compression, which is the condition of use in oil gas buoys. Moreover, the light produced from acetylene has a brilliant, penetrating quality, which makes it especially valuable for marine aid work. In addition to the inherent superior power of the light, we provide under our system for a very much larger gas supply than is contained in the ordinary compressed oil gas buoy."

TRADE PUBLICATIONS

GREAT BRITAIN

Lubricating oils, varnishes and paints are described in a catalogue published by Ragosine & Company, Ltd., Albion Wharf, Bow, London, E. This firm's "Fluxine" enamel is said to be especially suitable for yachts, ships' cabins, etc.

The Glacier Anti-Friction Metal Company, Ltd., of Glacier building, 112a Queen Victoria street, are exhibiting their Glacier Anti-Friction Metal, which is a metal especially adapted to the requirements of high-speed and heavy-pressure machinery, and also their Findlay's Special Motor Metal, which is a metal specially made for the bearings of motor cars, and is also suitable for gas engines and bearings generally that work under a pounding action. The company also make a good display of die cast bearings. Owing to their special process of casting these, they turn out rapidly bearings absolutely true to dimensions and ready for use, which require no machining after being cast. These bearings are of especial interest to the engineering trade, as it is, comparatively speaking, a new departure, and the process of manufacture is an exceedingly economical one.

A catalogue section, devoted to small electrical ventilating fans, has been published by the Electric & Ordnance Accessories Company, Ltd., Cheston Road, Aston, Birmingham. Desk, wall, ceiling and porthole fans for direct and alternating currents are dealt with, prices being stated for the fans and various accessories.

Messrs. W. N. Brunton & Son, of Musselburgh, Scotland, have issued a small pocket catalogue giving useful information relating to wire ropes. The diameters, weights, breaking strains and other particulars of ropes for winding, haulage and other purposes are given, and various fittings, such as haulage clips, safety detaching hooks, sockets, straining screws and other attachments are illustrated. Attention is called to the advantages of "Kilindo" ropes. These ropes, it is claimed, are free from any tendency to rotate, and wear is distributed over a very large surface; they are specially recommended for winding.

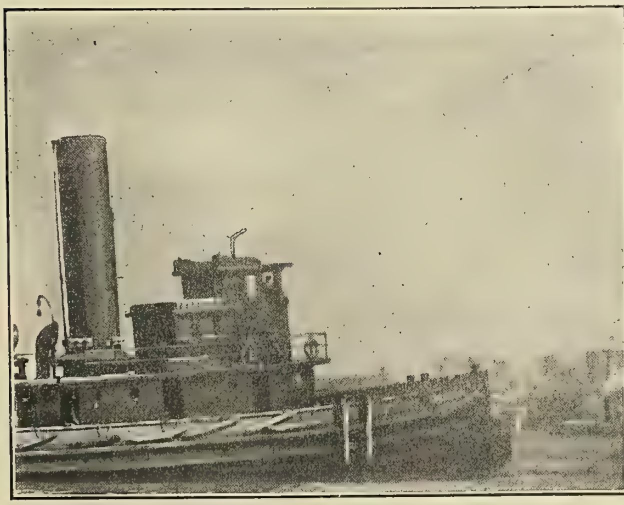
Trier Bros., Caxton House, Westminster, S. W., have published a catalogue of their products, which include Stauffer's lubricant and "Tell-Tale" and other lubricators suitable for use wit hthis lubricant. Trier's patent grindstone dressers are illustrated, also an excellent tool for truing emery and carborundum wheels. The "Split-Grip" set-collar for shafting, etc., is also described. The special features of this collar are that it has no projecting parts, and, being made in halves, is very easily placed in position on, or removed from, the shaft.

Messrs. Siemens Bros. & Company, Ltd., Caxton House, Westminster, S. W., have recently published some pamphlets illustrating and describing the "O. S." wiring system. This system employs "Stannos" wires, in which the conductor, insulated with rubber, is enclosed tightly in a small tube of tinned sheet copper. It is claimed that wiring on this system is very durable and reliable, and is easily installed, as the wires can be fixed on the surface of a wall without being unsightly.

Messrs. Princeps & Company, of Sheffield, have recently taken up two new branches of manufacture. One is metallic packings and piston rings, for which they have just received an order for work in connection with the Admiralty, and which have also been fitted to some of the largest winding engines in the country, including those at Edlington, Brodsworth Main, Maltby Main and other collieries. The second consists of separators, which are being made in competition with the manufactures of America and Germany. The firm have recently installed some modern plant for extracting oil from exhaust steam, compressed air or gases, at Butterley, Waleswood, Barrow Hematite, Tinsley Park and other mines.

Bateman's Machine Tool Company, Ltd., of Balm Road, Hunslet, Leeds, who are showing, besides their "Topspeed" planer, one of their new Planodrives. This machine is used for driving either new or old planers. It has not been exhibited before, but has been adopted by most of the leading shipbuilders and allied engineers. The Planodrive embodies the two Bateman patents and a complete set of gearing, so that it is applicable to almost every make of planer. The gearing of the old machine is, generally, in a worn condition, and immunity from breakdown is secured by the fitting of machine-cut gearing in the Planodrive, and discarding the old gearing and driving pulleys of the planer. The results obtained by means of the Planodrive are such that its relatively small cost is recouped within about twelve months in most cases.

A very useful catalogue of 70 pages, handsomely bound in leather, is issued by the Rivet, Bolt & Nut Company, Ltd., of 74 York street, Glasgow. The various manufactures of this company are illustrated, described and specified. The information given is full and complete, so far as the goods enumerated are concerned. The book professes to deal with the company's manufactures in general use, but does not pretend by any means to be exhaustive, and inquiries are solicited for bolts, nuts and rivets, etc., of any other description not included in the list. The company emphasize that they are accustomed to work to all known surveys, tests and inspections, and they have long held the British Admiralty and other important government contracts. By way of addendum, a good deal of useful information is added to the catalogue in the shape of tables and data relating to bolts, nuts and rivets.



BUSINESS NOTES

AMERICA

HELLER BROS., Marienthal, Germany, and the Deutsch Kugellagerfabrik, Leipsig, Germany, have made W. S. Rogers, president of the Bantam Anti-Friction Company, Bantam, Conn., sole American representative for their steel balls and ball bearings, and Mr. Rogers will open branch offices for distribution of their goods in Philadelphia and Detroit after his return from abroad. Evidently Mr. Rogers did not go to Europe just for play. He will have the handling of a well-known make of steel tubing as well.

THE AMERICAN ASSOCIATION OF COMMERCE AND TRADE, BERLIN, GERMANY.—"The above organization, an American Chamber of Commerce, founded seven years ago by Americans, and is run by Americans on American lines for the purpose of promoting American trade with Germany and German trade with the United States. This is a thoroughly American and hustling institution, organized especially for assisting American firms to start branches in Germany. The organization has the largest and most complete American reading room in the Empire, thirty daily American papers and 150 trade publications, all United States government reports and statistics, all the directories of the leading American and German cities, all the principal telegraph codes, all of which it places at the disposal of American business men and travelers visiting Berlin. This association appeals to all American business men intending to do business in Germany, whether temporary or permanent. It deserves the unqualified support of American business firms, as it can help them as no other institution or commercial agency can. Information given regarding business conditions in Germany, agents found, inquiries answered thoroughly and satisfactorily, and firms actively assisted in establishing branches."

A LETTER OF ENDORSEMENT, recently given by a high official of the Isthmian Canal Commission to the operator who had charge of the eight Lidgerwood cableways, made by the Lidgerwood Manufacturing Company, 96 Liberty street, New York, and used in building the Gatun locks during the preceding eleven months, contains, incidentally, a remarkable record of efficiency of the cableways. This passage read as follows. "These cableways, so far as delays from breakage or repairs were concerned, while working 12½ hours per day, have been kept up to an efficiency of 99 percent. That is to say, that during this whole period only 1 percent of time was lost on account of making repairs. The cableways referred to are eight of the thirteen cableways designed and built by the Lidgerwood Manufacturing Company for the Isthmian Canal Commission. The other five are used for handling the broken stone and sand for the concrete, taking it from barges and delivering it to the storage yards some 600 feet away on the average. The total to be handled will be 2,000,000 cubic yards of broken stone and 1,000,000 cubic yards of sand. The eight cableways for building the locks are used for placing the concrete and reinforcement and also for handling forms. They are traveling cableways of 800-foot span, operated electrically. They are handling on every working day more than 3,000 cubic yards of concrete. Up to June 4 there had been placed in the Gatun locks and its auxiliary plant 437,461½ cubic yards of concrete. The amount placed in the five days from May 31 to June 4, inclusive, was 16,809 yards, an average of 3,361 cubic yards per day."

THE WELIN DAVIT AND LANE & DE GROOT COMPANY, 17 Battery Place, New York, has closed orders for Welin quadrant davits to be fitted to the two new Merchants & Miners' boats built by the New York Shipbuilding Company, and also for the sister ship *J. A. Chanslor*, and for the new boat for the Department of Correction of the city of New York. Also four sets for the Dubuque Boiler & Engine Works, Dubuque, Ia.

OWING TO THE DEMANDS OF THEIR CUSTOMERS, the Eureka Fire Hose Manufacturing Company, 13 Barclay street, New York, has decided to open branch offices in the States of Minnesota, North and South Dakota, Iowa, Nebraska, New Mexico, Arizona, Nevada, Montana, Wyoming, Washington and Wisconsin. These branch stores will carry sufficient stock to meet all orders. Patrons will have the advantage of doing business direct with the Eureka Fire Hose Manufacturing Company instead of through agents as heretofore.

THE MARINE CANOE GLUE made by L. W. Ferdinand & Company, 201 South street, Boston, is guaranteed to be waterproof. "Its peculiar properties are those of flexibility and durability, and although it becomes soft and pliant under heat, it still retains its adhesion to timber, fiber, etc., and is clean and insoluble in water. No canoeist should be without a can of this glue; it is invaluable for quick repairs on either canvas or cedar canoes. Any puncture or leak in boat or canoe can be repaired in five minutes. It is as necessary to a canoeist as a repair kit to a bicyclist or an automobilist. Friction top emergency cans, 25 cents each, by mail 30 cents."

A LUBRICATING PROBLEM SOLVED BY FLAKE GRAPHITE.—A certain manufacturer had an order for a machine that included three hollow gunmetal rollers, one weighing 1,386 pounds, the other two weighing 752 pounds apiece. These rollers are heated by gas to a temperature of about 700 degrees, and it was found that any oil or grease would carbonize and cut the journals in a very short while. In this predicament it was suggested that the builders of this machine write the Joseph Dixon Crucible Company, Jersey City, N. J., concerning the use of graphite on the rollers. This was done, and proper suggestions were made for the use of Dixon's flake graphite to be used alone, and some months later the makers wrote the Dixon Company that the scheme had met with perfect success.

THE PHILADELPHIA OFFICE (Goodall Rubber Company distributors) of the Peerless Rubber Manufacturing Company, 16 Warren street, New York, has recently moved from 704 Arch street to larger quarters at 19 North Seventh street, Philadelphia, Pa.

WILLIAM J. DEED, JR., naval architect, Boston, Mass., specialist in the designing of power pleasure craft, has opened an office for the designing of all types of wooden commercial and pleasure craft at 113 Devonshire street. Those entrusting commissions to Mr. Deed are certain to be given the benefit of his personal attention and many years of practical designing.

BUSINESS NOTES

GREAT BRITAIN

THE BRITISH ADMIRALTY have placed a contract with Messrs. Yarrow & Company, Glasgow, for two torpedo boat destroyers of a special type involving many new features. In these vessels the constructors have been allowed to have a perfectly free hand in the design of the machinery, and consequently the trials of these destroyers will be awaited with considerable interest.

AT THE ANNUAL MEETING of R. Waygood & Company, the well-known lift manufacturers of London, the chairman stated: "The shareholders are aware that our company were responsible for the lifts erected on board the *Mauretania* and the *Lusitania*, at that time the two largest ships afloat, and it is most gratifying to be able to report to you that we have secured the order from Messrs. Harland & Wolff to fit the new mammoth White Star liners, *Olympic* and *Titanic*, with sixteen lifts, including eight of our special electric passenger lifts. These ships are to be something entirely new, both in size and equipment, in passenger vessels, and, having done so much of this class of work and made a specialty of it, we were able to satisfy Messrs. Harland & Wolff's very stringent conditions, and so undertake the work for them. We have now fitted over fifty ships with our lifts, quite apart from the special work we have done in this direction for the Admiralty, for whom we have fitted thirty electric lifts on battleships and cruisers. These facts prove conclusively that the high reputation of the company in all the latest improvements in this branch of engineering has been fully maintained."

A HANDSOME GUNMETAL WATCH FOB will be sent free to any of our readers who will mention this magazine by the E. M. Dart Manufacturing Company, Providence, R. I.

IN ACCORDANCE WITH PREVIOUS ANNOUNCEMENTS, the autumn meeting of the Iron and Steel Institute will be held at Buxton, on Monday, Tuesday, Wednesday, Thursday and Friday, Sept. 26-30, 1910. An influential reception committee has been formed, with the Duke of Devonshire as chairman, Sir Alfred S. Haslam as vice-chairman and Major A. Brown as honorary secretary.

ON THE GROUND ACQUIRED SOME TIME AGO, which was formerly the shipyard of Messrs. Robert Napier & Sons, the London & Glasgow Shipbuilding & Engineering Company, Ltd., Govan, are laying out new building berths and workshops, as well as constructing a tidal basin for the outfitting of naval and mercantile ships. Hitherto the vessels from their stocks have been accommodated in the river alongside the yard. One building berth is being provided which will be capable of accommodating vessels of the largest dimensions and heaviest tonnage now built; it will have a length of 700 feet, and will be suitable for vessels of 80 feet to 100 feet beam. Concrete and timber piling are being largely used for foundation work. The berth is disposed obliquely to the line of river, and in such a way as to afford a good "launching run." The tidal basin is to be 750 feet long by 270 feet wide at the mouth; it will have a depth of water equal to 29 feet at the lowest tides, and will thus conform to Admiralty stipulations regarding the necessity of keeping large vessels afloat while being fitted out. The company are also increasing their engine shops to about double the previous size. A new shop will be devoted entirely to erection work, while the machine shop will be extended to about double the original dimensions. New plant will be installed in these shops in the form of planing, turning, and other tools, to deal with engine work of the largest class, and special lathes will be provided for turning the rotors and other parts of turbine engines. Most of the new tools are by Messrs. Thomas Shanks & Company. The steel constructional work of the new shops is by Messrs. A. & J. Main and Arrols' Roof & Bridge Company, Glasgow. The contractors for dock construction, etc., are Messrs. Kinnear & Moodie, Ltd., Glasgow.

THE NAVAL, MERCANTILE MARINE AND GENERAL ENGINEERING AND MACHINERY EXHIBITION, which was opened at Olympia, London, W., on Sept. 1, and continues to the 26th, has proved a very great success. The exhibition reflects the strides that have been made in engineering science during the past three years, and many of the lastest inventions are on view for the first time. Visitors to the exhibition are arriving from all parts of the United Kingdom, from the Colonies and abroad. Among the exhibitors our representative noticed the following:

MATTHEW KEENAN & COMPANY, LTD., Tredegar Road, Bow, London, E., and 80 Great Wellington street, Glasgow, will have a very full exhibit at the Naval and General Engineering Exhibition, Olympia, of all the various methods and styles of covering boilers, steam, hot water, cold and refrigerating pipes, etc., also oils, packings and planished steel and other sheet metal work. Messrs. Keenan & Company report that they are now experiencing an enormously increasing demand for their various specialties; that they are busy getting out a new catalogue dealing with these which will shortly be ready for distribution. Messrs. Keenan & Company will have stand No. 241 at the above-mentioned exhibition.

MESSRS. ALLEN & SIMMONDS, LTD., of the Thames Side Engineering Works, Reading, Berks, show the several types of their "Allen" patent frictionless piston and piston valve packings, including Mr. Allen's latest improvements, by full-sized working models, also models of his patent frictionless rod packings. Each of these specialties has been considerably improved within the last twelve months. Messrs. Allen & Simmonds also exhibit models of the improved Presto davit gear, of which they are the sole manufacturers. This is stated to be the most up-to-date davit gear for launching ships, lifeboats, etc., and is very simple, strong, powerful and quick in action. The firm also show their new perfect "Allen" combustion furnace bar, etc., gear, and "Smith" patent exhaust steam water heater. This heater is certainly one of, if not the, simplest apparatus in use for feed heating from exhaust steam. Other specialties exhibited include their special cast iron mixtures, for valve and cylinder liners, valve packings, etc. The characteristics of these metals are that they are very tough and hard, with natural slippery surface.

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

H. W. WARD & COMPANY, LTD., machine tool makers, of Lionel street, Birmingham. The chief machines exhibited on their stand are their combination bar and chucking lathes, small wire feed capstan lathes, universal grinding machines, sensitive drilling machines, newly-designed all-gear milling machines. The whole of these are in operation, and form an interesting exhibit to all users of such tools.

NO EXHIBITION OF ENGINEERING APPLIANCES would be complete without a show of the oil cans and oil economizers manufactured by Messrs. Joseph Kaye & Sons, Ltd., of Leeds and Holborn, London. Messrs. Kaye & Sons make oil cans in all sizes and all shapes, as well as seamless torch lamps and bunker lamps. A special feature of their stand is the exhibit of Kaye's improved economizers for preventing the waste of lubricating oils in works, factories and garages.

DROP FORGINGS.—Messrs. Thomas Smith & Sons, of Saltley, Ltd., of Birmingham, are showing drop forgings or stampings for engineers, shipbuilders, etc., in steel or iron. They also show engineers' tools, particularly spanners and lathe carriers, hammers of every description (engineers', fitters', sledge, etc.), axes and tools for all purposes. In addition to drop forgings, the firm exhibit specimens of pressed steel work, which is a specialty of theirs. Having powerful presses, the firm are able to produce pressed or cut-out articles in steel up to ¾ inch thick.

A VERY INTERESTING EXHIBIT is that of Messrs. J. Dampney & Company, Ltd., of Cardiff. They include on their stand: "Apexior" compound, a new process for preventing incrustation and corrosion in steam boilers, which is not a boiler fluid but a compound having a base of 98 percent carbon, applied direct to surfaces like paint. "Apexior" No. 3, which is a new compound for preventing the formation of rust and corrosion in all its forms on metal surfaces exposed to the weather or acid or alkaline influences, also for withstanding the effects of great heat on steel smokestacks, also for preventing pitting and corrosion on cast steel propeller blades, and for preventing galvanic action which takes place in the stern portions of steamers fitted with bronze propellers. Enameline antifouling compositions for ships' bottoms, which has now been on the market for twenty years, and stocks of which are held at most ports in the world. "Miraculum" graphite paint, a most efficient preparation for coating structural iron and steel work, having as a basis a graphite containing 98 percent carbon. Semper mollis, a preparation which never dries and which may be applied to metal or other structures under water, and which, owing to its non-oxidizing properties, forms an ideal preventative against corrosion, where its nature is not objectionable, such as confined places like cellular double bottoms of ships, the interior compartments of floating drydocks, etc. The firm also include samples of their Perfect Paints, which are supplied ready mixed for use on board ships, and which contain a special varnish enabling them to be washed and scrubbed without injury to the surfaces, thus proving exceedingly economical.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
39 Elmbank, Crescent.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

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THE STORY FEED PUMP.—Messrs. Isaac Storey & Sons, Ltd., of the Empress Foundry, Cornbrook, Manchester, exhibit the "Storey" feed pumps, Edwards' type air pump, suitable for surface and other condensers, and some of their standard gunmetal steam fittings. The "Storey" feed pump is quite new, and has only just recently been put upon the market. It has features of special interest in regard to the valve gear, and is a particularly interesting exhibit.

DEXINE PACKING.—The Dexine Patent Packing & Rubber Company, Ltd., Stratford, London, E., are amongst the exhibitors with their well-known packings and specialties. They show their extensively-used high-pressure steam jointings, as used by the Admiralty and the leading steamship companies, valves and washers, wheel and roller covering, insulating materials, etc. Dexine gage glass rings is one of the special lines shown, and Dexine packing for steamer doors, also for oil-fuel tanks.

A SERIES of pneumatic hose fittings has recently been brought to our notice by J. Cowens & Company, Newcastle-on-Tyne, who have named them the Titan fittings. It is well known by users of compressed air that it is a difficult matter to prevent leakages in the system. Sometimes these leakages occur accidentally; sometimes the air is put to improper uses, such as the clearing of holes and the cooling of tanks and holds in warm weather, notwithstanding the fact that orders shall have been given that the air shall not be so used. It is with the objects of minimizing as far as possible the accidental losses, and of practically preventing improper use, that the fittings which we propose to describe in the following article have been put upon the market.

TRADE PUBLICATIONS.

AMERICA

The Jenkins automatic liquid discharger, operated by steam or compressed air, absolutely automatic, is described in Catalogue E, issued by A. B. Sands & Son Company, 20 Vesey street, New York. It elevates from 2,000 to 4,000 gallons per hour of sewerage and liquid wastes from below the sewer or water level from 4 to 40 feet. Composition cylinder, with special inlet and outlet valves. Is especially adapted for yachts, ocean liners, steam vessels, buildings and any place where liquid is to be elevated from one level to another. Can furnish, complete, air compressor, tank and necessary fittings if desired, when same is to be used with air. Full particulars given upon application to the manufacturer.

Monel metal is described by the Bayonne Casting Company, Bayonne, N. J., in catalogues this company has published. The statement is made that this metal is non-corrosive and stronger than steel; that it is a natural alloy of nickel and copper, containing about 68 percent nickle. "Castings are furnished up to 20,000 pounds in weight in one piece. Deck fittings, propellers, struts, pump ends, cylinder linings, pump pistons, steering gear fittings, etc., etc. Two recent governments tests show: tensile strength, 77,800-72,700; elastic limit, 38,400-38,700; elongation, 46 percent, 33 percent; modulus of elasticity, 22,000,000. We are prepared to furnish from stock hot rolled round rods from 1/8 inch up to 3½ inches in diameter, also squares and hexagonals. These are extensively used as pump rods, rudder posts, valve stems, stanchions, belaying pins, etc., etc. Two recent governments tests show: Tensile strength, 87,750-82,500; elastic limit, 52,250-55,750; elongation, 44 percent, 41 percent; modulus of elasticity, 22,000,000. Monel metal retains 85 percent of its strength at 1,000 degrees F. temperature. Monel metal pump rods do not score or cut out the packing. We have on contract four 8,000-pound propellers for the United States ship *Florida,* and also twelve 15,000-pound propellers for the two 28,000-ton Argentine Republic battleships. We have supplied castings and rods to the United States, English, Italian and Japanese navies."

In a 96-page book, entitled *High Efficiency of Centrifugal Pumps,* the De Laval Steam Turbine Company, Trenton, N. J., has brought together some 75 charts, diagrams, photographs and a vast amount of engineering information relating to such subjects as ways and means for testing centrifugal pumps, charts of the results of such tests, the interpretation of these charts for the purposes of the engineers, etc. The book also discusses the relative importance of different features of pump design, as accessibility, the influence of impeller design upon the efficiency, the question as to the desirability of diffusion vanes, the methods of preventing leakage between the discharge and suction chambers, the use of suitable bushings, sleeves, etc., to prevent corrosion of important parts, the manufacture of pumps to limit gages so that all parts are strictly interchangeable, the balancing of multi-stage pumps, and the design of bearings for high speeds. It then takes up the adaptation of centrifugal pumps for all methods of driving and classes of service. Characteristics are shown for many centrifugal pumps. In each of these curves the conditions for which the pump was designed are also indicated, to illustrate the accuracy with which characteristics can be predetermined by the designer. Some of the efficiencies shown are very good; for instance, 84 percent for a 16-inch pump. An illustration is also given of an undesirable form of characteristic, as shown by a great many centrifugal pumps. The pumps illustrated are adapted for delivering against heads varying from a few feet up to 1,600 feet, as for hydraulic pressure service, while the capacity varies from small boiler feeders up to pumps delivering 30,000 gallons per minute. The De Laval centrifugal pump herein described is said to differ from most pumps on the market in its ability to pump against high heads per stage (as much as 500 feet); in fact, that the highest efficiencies are obtained without the use of diffusion blades, in the use of a split casing, which permits moving parts to be inspected or removed upon the breaking of one joint, without the disturbance of suction or discharge connections, etc. Valuable suggestions are given for the drawing up of specifications and for testing pumps, to ascertain whether or not specifications have been made. In this connection it is stated that the De Laval Steam Turbine Company guarantees beforehand the characteristics of the pumps built by it and subjects each pump to a thorough test at the works. The purchaser is invited to witness this test and a full report is supplied to him. This book will undoubtedly prove of interest to anyone having to do with pumping machinery in any way.

Every rope buyer should write the Plymouth Cordage Company, North Plymouth, Mass., mentioning this magazine, and ask to be put upon the free mailing list of the company's series of bulletins entitled *Plymouth Products.* Plymouth rope has been made for eighty-five years, and the company states that high-grade manila hemp and Plymouth workmanship make it the rope most sought for by marine buyers.

Catalogue 18-L, published by the L. S. Starrett Company, Athol, Mass., should be in the hands of every marine engineer. Among the hundreds of tools and instruments of precision described and illustrated in this catalogue is a gage which is especially designed for the use of marine engineers, machinists and others desiring a set of gages in compact form. The taper gage shows the thickness in 64ths to 3-16th of an inch on one side, and on the reverse side is graduated as a rule 3 inches of its length, reading in 8ths and 16ths of an inch. The wire gage, English standard, shows on one side sizes numbered from 19 to 36, with two extra slots, one 1-16, the other ⅛ of an inch, and on the reverse side shows the decimal equivalents expressed in thousandths. This gage has also nine thickness of feeler gage leaves, approximately 4 inches long, of the following thicknesses: .002, .003, .004, .006, .008, .010, .012, .0.15 and 1-16th of an inch, all folded within the case, which is 4¾ inches long, convenient to handle or to carry in the pocket.

Two inclined elevators are shown in operation on the New York, New Haven & Hartford dock at Bridgeport, Conn., in a catalogue published by the Reno Inclined Elevator Company, 553 West Thirty-third street, New York. "This method of conveying trucks is entirely new, and the simplicity of the design and economy in first cost will appeal to the superintendents of docks, warehouses and other situations where loaded trucks are to be conveyed up and down an incline. It consists of an endless steel chain supported by and sliding in a lubricated steel channel and kept in motion by sprocket wheels driven by an electric or steam motor. The chain is provided with projections which engage the axle of the truck, leaving the wheels to rest the load. In tidewater docks, when the platform floats to level and the chain becomes unnecessary, one man can quickly lower the whole machine and fit the steel plate covering in the channel. When needed it can as quickly and simply be raised to position. It is readily controlled, started, stopped and reversed by a switch, and is perfectly safe for the workmen. Send for full description and economy figures."

High-pressure blowers are the subject of Catalogue 175 published by the B. F. Sturtevant Company, Hyde Park, Mass. "The reputation and high standing earned by the Sturtevant fans and blowers during the last fifty odd years are sufficient guarantee of the stability and efficiency of this high-pressure blower. Furthermore, we not only know from a theoretical standpoint, but from practical use, that the Sturtevant high-pressure blower is not only very efficient, but will outwear other types of high-pressure blowers, because in the Sturtevant there is practically no driving power transmitted through the gears, as is shown in the detailed description found later in the catalogue. Another special point of superiority is that the Sturtevant high-pressure blower discharges air at a more constant pressure and with less pulsations than any other high-pressure blower made. A very important point for you as a purchaser to consider when looking up a high-pressure blower is that we make all kinds of air-moving blowers, and consequently have no desire to sell you a high-pressure-type blower if a centrifugal fan is what you should have. We make disc and propeller fans to move large volumes of air against resistance less than 1 ounce per square inch, centrifugal fan blowers handling large volumes at moderate pressure, and the high-pressure blower herein described for handling air up to 5 pounds per square inch. Where the pressure required is over 5 pounds we do not generally recommend our apparatus. It is therefore readily seen that, from a standpoint of giving the best engineering advice and recommending the proper apparatus to best do your work, we are in a position to recommend what our fifty years of experience in mechanically moving air shows to be the best for you, without being under the slightest temptation to sell you a high-pressure blower when you should use a centrifugal fan, or a centrifugal fan when you should use a high-pressure blower. Many customers like to do business with us because we manufacture both the fan and the engine, motor or turbine to drive it, thus saving them dividing the responsibility for the different parts among different manufacturers. Sturtevant electric motors, steam engines and turbines especially adapted for driving these blowers are illustrated and described in detail in separate bulletins sent on request."

Tackle blocks are the subject of a cloth-bound illustrated catalogue of 180 pages just issued by the Western Block Company, Lockport, N. Y. This company makes a great variety of blocks especially suitable for marine use, and we understand that a copy of this catalogue will be sent free to each of our readers who mentions this magazine. Every kind of block made is listed in the index, from "anvil steel blocks" to "yacht blocks."

"What the Motorist Should Know" is the title of a booklet issued by the Vacuum Oil Company, Rochester, N. Y. This booklet is devoted to describing the lubricating products of the Vacuum Oil Company, especially as applicable to aeroplanes and automobiles. There are many interesting illustrations in this book, showing, among others, the Zeppelin airship over Berlin, Curtis in his aeroplane during his flight from Albany to New York, Latham crossing the English Channel, and many others.

A free instruction book, telling how to make many permanent repairs to boilers, engines, tanks, piping, castings, etc., will be sent to any engineer mentioning this magazine by the Smooth-On Manufacturing Company, Jersey City, N. J.

The twelfth edition of Travers' *Marine Directory for* 1910 has just been issued by J. L. Travers, Duluth, Minn. This is a vest-pocket-sized booklet of 100 pages, and is said to contain the name of every ship on the Great Lakes, the name and address of the owner and the name of the captain and chief engineer.

Gasoline motors for commercial service, built in sizes from 12 to 2,000 horsepower, are described in a catalogue issued by the Standard Motor Construction Company, 180 Whiton street, Jersey City, N. J. Many "Standard" motors are now in use in coastwise schooners, fishing schooners, towboats, oyster dredges and in freight and passenger service.

Marine packing is described in a catalogue published by Greene, Tweed & Company, 109 Duane street, New York. A free working sample will be sent to any of our readers who will mention this magazine. Regarding the packing, the catalogue makes a statement that "if a packing does not possess tensile strength you cannot expect it to withstand the destroying tendency of high-pressure steam. Test the tensile strength of a single strand of Palmetto packing, and then multiply that by the great number of strands that are braided together. In the factory we test each strand in a sensitive machine to insure uniformity of tensile strength, but your hands will give you some idea of its great strength. There is no guesswork about Palmetto, that is why it is so uniform in its quality and lasts so long. If you are not using it you ought to send for a free working sample at once."

The use of the triplex chain block in the lifting of loads is the subject of a booklet published by the Yale & Towne Manufacturing Company, 9 Murray street, New York. A free copy of this booklet will be sent to anyone mentioning this magazine. "The lifting of loads is a universal need—a vital factor in every man's business. The triplex block is the simplest, safest, most efficient and most economical load lifter in the world. It lifts loads under all conditions, in all places, from a palace to a sawmill, a garage to a warship. When one man pulls on the hand chain of the triplex block he can lift any load from 200 pounds to 20 tons—two men can lift 40 tons. The load is always automatically held at any point during the lift. You can go away and let it hang ten seconds or a year. It will not come down until you are ready. Then you lower it by pulling lightly on the reverse side of the hand chain. The triplex block has the strongest, simplest, smoothest-running, wear-resisting system of gears ever devised to multiply lifting power. It so multiplies the strength of one man as to make him master of every lifting problem. Many loads must also be transported—moved horizontally. The triplex block not only lifts its load easily, and holds it suspended safely, but when hung from a trolley running on an overhead track the load may be moved easily wherever the overhead track goes. One man can push the load as easily as he lifts it. In foundries, machine shops, factories, sawmills, mines, quarries, warehouses, in power houses and boiler rooms, on railways, ships and docks, thousands of triplex blocks are daily lifting and transporting thousands of tons, at a saving in labor which frequently repays the whole cost of installation in six months. Everyone who has lifting and transporting to do should write for the book about triplex blocks. A postal brings it."

Heavy-duty slow speed motors, designed expressly for use in fishing, towing and passenger boats, are described and illustrated in a catalogue published by the Truscott Boat Manufacturing Company, Box 600, St. Joseph, Mich.

"A Perfect Log" is described in a catalogue published by the Schuette Recording Compass Company, Manitowoc, Wis. The catalogue states that this compass will keep an accurate automatic record of how your ship is steering; that it will show what course you are steering and the exact time when the course was changed.

"The Book of Hoists," published by the Yale & Towne Manufacturing Company, 9 Murray street, New York, shows many of the advantages of a triplex block on board ship. "For taking off a cylinder head and putting it back, in close quarters, there's nothing like a triplex block. Hung from a rod or trolley, as shown in the picture, you have only to lift it clear of the bolts and push it to one side. When your job is done, you slide it back, lower it into place and bolt it down. And it is just as handy for motors, dynamos, pumps or any odd jobs. Nothing else takes its place on board ship. It is the best hand hoist made. You may have one to try by just asking us or your nearest dealer. Chain blocks: Four styles, differential, duplex, triplex, electric. Forty-two sizes, one-eighth of a ton to 40 tons. Three hundred active stocks ready for instant call all over the United States."

TRADE PUBLICATIONS

GREAT BRITAIN

The progressive firm of The Appleby Crane & Transporter Company have a new general catalogue which is printed in Spanish, and has been prepared for the South American market and the Spanish-speaking countries. Cranes of all descriptions are illustrated and described. The prices are given in both pounds and francs. The city address of the firm is 58 Victoria street, London, S. W.

The Eastern Press, Ltd., 3 Chancery Lane, London, E. C., has published an excellent *Who's Who in British Engineering and Kindred Industries* at 10/6. The new list is intended to amplify the information given in an ordinary trade directory, the object being to give in a concise form all the British firms associated with engineering together with a list of their principal productions. There is also included a useful classified list of manufactures, enabling instant reference to the firms who specialize in any particular goods. The book is in its first edition, and there is no doubt that omissions, which are inherent in a work of this sort, will be put right in the future.

One of the latest additions to Nash's Standard Library is Admiral Sir William Kennedy's *Hurrah for the Life of a Sailor!* Sir William's entertaining and interesting book is fairly well known, but this two-shilling edition, which, by the way, is particularly well got up, will bring it within the reach of a still wider circle of readers. Sir William opens with an interesting chapter of seven pages on the navy as it was fifty years ago. We then follow him through his eventful naval career, which began with the Crimean and then the China campaign of 1856-59. Sir William has seen life in all climes, and on all seas except the Arctic, and this work, which traces the changes in the navy during the last half century, is full of incident, and constitutes a particularly readable volume for "after hours."

Eveleigh Nash, of 26 King street, Covent Garden, London, has favored us with an excellent collection of humorous stories written by Morley Roberts. They are well up to the standard of this well-known short story writer, and make lively reading for an off moment. The seven stories are full of variety, and the whole book is a good two shillings' worth.

Clark, Chapman & Company, Ltd., Queen Anne's Chambers, Broadway, Westminster, S. W., have published a pamphlet descriptive of the Clark, Chapman watertube boiler. It is a well produced little publication, setting out the special features of these boilers. Dimensions, code words and other information of interest to buyers are included.

The India Rubber, Gutta Percha & Telegraph Works Company, Ltd., of Silvertown, London, E., have issued a very well got-up catalogue dealing with india rubber tiling. The many colored illustrations which it contains are splendidly produced, and the paper used is very fine indeed. The india rubber tiling or paving dealt with in the catalogue is specially suitable for use aboard ships and yachts. This form of flooring is supplied in separate tiles, fitting quite closely together in a good variety of colors, which permits of an almost unlimited range of designs according to taste.

Lubrication Without Oil or Grease.—The "Cromil" Engineering Company, Northern Assurance building, Newcastle-on-Tyne, states that the list of firms "to whom we have supplied appliances for lubrication without use of oil or grease has extended rapidly, and we shall be glad to forward on request illustrated pamphlet showing the system actually applied to engines, turbines, pumps, etc. We are advised that apart from other economy and advantages the saving in piston rings and cylinder liners quickly justifies the merely nominal outlay of 6 guineas, which sum covers the cost of license to use the system, the patent lubricator, measuring flask, and 1,000 charges of the special Acheson graphite (over 99 percent purity), which ought to last for several months. We suggest that you arrange for a practical trial straightway. You may return the goods if not satisfied, or pay our account, one month after delivery. Equal success is attending the use of Aquadag (Deflocculated Acheson Graphite suspended in water), which may be fed through most ordinary lubricators already fitted, and which, moreover, is proved to be a superior screwing mixture."

BUSINESS NOTES

AMERICA

THE FIRM OF AUGUSTIN NORMAND, Havre, France, writes INTERNATIONAL MARINE ENGINEERING that it has received an order from the French Minister of Marine to build a mine planter to be named *Le Pluton.*

WELIN QUADRANT DAVITS.—The Welin Davit and Lane & De Groot Company, Con., 305 Vernon avenue, Long Island City, N. Y., has recently received an order for sixteen sets of davits for the two ships building at the New York Shipbuilding Company's yard for the Merchant & Miners' Transportation Company. Regarding the Welin boat and launch department, the company states that it has increased its sales 50 percent over last year, and that during the spring season of 1910 they sold 10,000 life preservers, manufactured and delivered 180 lifeboats, 20 rafts and 18 steel and wooden launches, besides several bronze boats and many repair jobs which kept their repair men continually busy. Among other work, the company has just completed and delivered a 28-foot launch to the Coast and Geodetic Survey, and 6 power boats to the Lighthouse Service.

A FREE SAMPLE OF ASBESTOS-SPONGE felted covering will be sent on application to any of our readers by the H. W. Johns-Manville Company, 100 William street, New York. "The tempearture of high-pressure pipes soon dries out molded and ordinary pipe coverings. Then expansion and contraction of the pipe and vibration reduce the carbonate of lime (chalk) and other like materials with which these coverings are filled to a powder. This powder settles at the bottom of the canvas covering, leaving the top insufficiently covered, and gradually sifts through the canvas. Thus what little insulating properties they originally had are quickly lost. J-M Asbesto-Sponge Felted Pipe Covering retains its high insulating properties indefinitely. Pipes covered with it can even be walked upon without injury. This is because it is made of layers of fine paper, composed of pure long-fibered asbestos and a small quantity of granulated sponge. It has been found in perfect condition after more than fifteen years' service on underground pipes. Can be taken off pipes and replaced without injury. This is an important feature around manufacturing plants where changes are constantly occurring."

REMOVAL NOTICE.—The Welin Davit and Lane & De Groot Company, Con., has moved its main office to the company's works at 305 to 315 Vernon avenue, Long Island City, N. Y.

THE L. S. STARRETT COMPANY, Athol, Mass., announces that its Chicago store is now permanently located in new and larger quarters at 17 North Jefferson street. The company cordially invites its friends to call and inspect its complete line of fine mechanical tools and its improved facilities for favoring trade with prompt and efficient service.

THE ATTENTION OF SUBMARINE ENGINEERS, shipping men, dredging contractors and masters who may be looking for a business is called by the Lake Submarine Company, Bridgeport, Conn., to the great money-making opportunities which exist in modern submarine engineering—recovering wrecks and sunken cargoes, removing rocks, dredging improvements, submarine tunnel construction, improving waterways, shell, pearl and sponge fisheries, etc. This company states that all classes of engineering work can be done under water with great rapidity, and without the danger incident to old-time methods, by the specially designed machinery it makes.

TESTS OF SPELLERIZED STEEL BOILER TUBES are described by the National Tube Company, Frick building, Pittsburg. "The Spellerized steel boiler tube is subjected to many rigid tests before shipment. In previous announcements we have described the crop end test, the inspection test (interior and exterior), and the hydraulic test. We now describe the flange test. Samples from five (5) out of every one hundred (100) tubes are taken, these samples being approximately one inch (1 inch) long. With a tapered pin these are expanded, and then with the aid of a steam hammer are flattened, and where the diameter was originally about 2 inches O. D. the tube is flanged out to a diameter of approximately 3 inches O. D. This test is frequently extended, and not only one side, but both sides of the tube are flanged out, and then flattened back against themselves, thus clearly showing the excellent character of the material. If the material were not of the very best it would show fractures under this punishment. (This flanging is done while the tube is cold.) In case of failure the entire lot is under suspicion, and each tube must pass an individual flange test, and those that fail are consigned to the scrap pile."

BUSINESS NOTES

GREAT BRITAIN

NEW PATTERNMAKING SHOPS.—David Brown & Sons, Ltd., of Huddersfield, are transferring their East Parade Pattern Works to Lockwood, where new shops, covering an area of 14,000 square feet, are being erected alongside their foundry and gear works. These new premises will be replete with all the latest woodworking machinery, extensive stores, drying sheds, stoves and timber yard. We learn they are very busy on all classes of work, from motor patterns to large marine turbines.

AMONG THE ADVANTAGES of C. C. metallic mirrors for searchlights, which are made by the Reflector Syndicate, Ltd., 82 Victoria street, Westminster, London, S. W., are that they are not factured by concussion, and that even when they are penetrated by bullets the area of distortion is very small; that the light reflected from these mirrors is more penetrating in fog and at night; that the combination mirrors of gold and silver bands retain the dazzling effect required for military purposes; that the object on which the light is thrown stands out in greater relief; that the intenssity of light is so great that it is impossible to aim accurately at the projector; that these mirrors are lighter than glass mirrors and more durable, besides reflecting a larger quantity of light.

"THE WELL-KNOWN HOWDEN PATENT SYSTEM of forced draft, which has been in use by many of the leading steamship companies of the world for a long period of years, has for some reason or other not been adopted to any extent in dredgers. The reasons for this somewhat curious state of affairs are not apparent on the surface, for, as a matter of fact, the unique advantages which the Howden system confers in the way of great economy of fuel and increased steaming power of the boilers would be even more marked in the case of this type of vessel where the load is fluctuating and where specially heavy demands for steam are occasionally required. The magnificent results in economy and efficiency obtained in the two Bombay dredgers *Kalu* and *Jinga,* in which Howden's forced draft was fitted to the boilers, have, however, proved to the world that that system is the best method of combustion for dredger boilers as well as for the boilers of ocean-going vessels of all other types."

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (8 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Young man of 30, connected with the technical staff of various shipbuilding companies for the past ten years, desires to receive proposition to act as general agent or as Southern representative for marine specialties, or would consider any Atlantic Coast territory. Address *H. B. H.*, care International Marine Engineering.

Thoroughly Experienced Engineer (English), age 28, is open for engagement. Will go anywhere to secure a good position. Is thoroughly trained in all branches of marine and mechanical engineering, both practice and theory. Served apprenticeship of five years in one of the leading shipyards of Europe; has had over five years' sea experience as engineer with one of the premier steamship companies of the world; has had charge of large numbers of men on both land and sea; can produce excellent papers and is well recommended; is smart, brainy and not afraid of work. Three years' experience with turbines. Address *Expert*, care International Marine Engineering, 17 Battery Place, New York.

Yarrow & Company, Glasgow, have in hand two destroyers for the British government of a special type. They are building in Holland two destroyers, 230 feet long by 21 feet 6 inches beam, for the Dutch government. They also have in hand one destroyer for the Portuguese government, the hull of which is being built in Lisbon and the machinery and boilers supplied from Messrs' Yarrow's works at Glasgow. They are also building two fast gunboats, propelled by internal-combustion engines, for the Governor-General of Bagdad.

EXHIBITS AT THE NAVAL MERCANTILE MARINE AND GENERAL ENGINEERING AND MACHINERY EXHIBITION

Babcock & Wilcox, Ltd., Oriel House, Farringdon street, London, E. C., showed one of their portable boilers for the supply of steam to exhibitors for running their machinery. The company also took space for exhibiting models of boilers, samples of the wrought steel steam piping which their company manufacture, and a model of the Lassen & Hjort water softener.

Clark, Chapman & Co., Ltd., Victoria Works, Gateshead, showed a number of photographs of the various productions of the company, including ships' deck machinery, windlasses, winches, capstans, etc., driven both by steam and electricity; electrical machinery of all descriptions, including hauling gears, searchlight projectors, etc., also watertube boilers, steam pumps, etc.

Combination Metallic Company, Ltd., Gateshead-on-Tyne. A number of new and interesting marine specialties, together with the well-known combination metallic packing, Moller and C. M. P. automatic drain valves for steam whistles, syren, etc.; mechanical force sight feed lubricators, and the new form of C. M. P. metal jointing rings and metal sheeting with sample rings.

Royles, Ltd., Irlam, near Manchester, exhibited Row's patent calorifiers, feed-water heaters, steam kettles, gas kettles' evaporators for marine requirements, instantaneous water heaters and fresh water condensers for bath and lavatories, live-steam type feed-water heaters for marine requirements and air heaters; also Royle's patent syphonia steam traps, gunmetal valves and fittings, flanged couplers for copper pipes, etc.

Perkin & Compan, machine tool makers, Lord Street Works, Leeds. Machine tools of various kinds, such as lathes, slotting machines, disc grinders, drill grinders, emery machines, etc.

Many other exhibits were described in our September number.

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
39 Elmbank, Crescent.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
First Vice-President—Art Hyde, 9115 Willard Ave., N. W., Cleveland, Ohio.
Second Vice-President—Wm. P. Tindall, 180 Twentieth St., Detroit, Mich.
Third Vice-President—Charles N. Vosburgh, 6323 Patton St., New Orleans, La.
Secretary—Geo. A. Grubb, 1040 Dakin St., Chicago, Ill.
Treasurer—A. L. Jones, 38 Avery Ave., Detroit, Mich.

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Secretary—Wm. L. Bridges, 784½ Twelfth St., Milwaukee, Wis.
John A. Watts, 318 Fifth St., S. E., Washington, D. C.

TRADE PUBLICATIONS.

AMERICA

A flare light for stevedore's use and for light work on dock piers, dredges, etc., is the Willson flare light, made by the United States Marine Signal Company, 170 Broadway, New York. This light, the manufacturer states, will not smoke, sputter, flicker or smell, and the flame cannot be extinguished by the wind. "This light is an acetylene gas light, giving 8,000 candle-power, and, upon one charge of 18 pounds of carbide, will operate for over twelve hours at a net cost of 5 cents per hour. Our light is simple, economical and absolutely safe. The total weight when charged is less than 200 pounds. We also supply an extension outfit and flexible air tool hose by which the light can be carried any distance to where it is to be used, or put any place where it is impossible to locate the generator." A copy of this company's catalogue will be sent to any of our readers upon application.

Belting, hose and packing are described in handsomely printed and illustrated circulars issued by the Peerless Rubber Manufacturing Company, 16 Warren street, New York. Regarding this company's "Rainbow" packing the circulars state: "It packs any kind of steam, air or hot-water joint; it is a non-conductor, and lasts longer than any other packing in use. 'Rainbow' is the most durable, effective and economical packing made, and the users of steam have long felt the need of an article that could be adapted to all the uses that packing is put to. Joints can be made and broken in one-eighth the time consumed with packings that harden, as a tool is not required to break or face off joint. 'Rainbow' will make a tight joint, however rough the surface may be to which it is applied. It is not affected by oils, ammonia, liquors, steam, heat or alkalies. Unlike plumbago and other sheet packing, it will not harden or crack."

A free copy of a book on high-efficiency centrifugal pumps will be sent to any of our readers who will mention International Marine Engineering by the De Laval Steam Turbine Company, Trenton, N. J. This is the company's Publication No. 46, and consists of 96 pages. It discusses the tests of centrifugal pumps, the preparation of characteristic curves and the interpretation of such curves for the purposes of the engineer. It tells how to select a pump to meet the conditions of a given service, and how to draw up specifications so as to insure that you will get the pump you want. The book also takes up the various details of design, giving the reasons why one construction is preferred to another, and the statement is made that the split-casing pump, in which all parts and passages are at once accessible upon breaking one joint, is superior to the old-style side-plate pump, and that the small pump impeller is superior in efficiency and durability to the large pump impeller. The statement is also made that in actual practice diffusion vanes are a hindrance rather than a help to efficiency.

The "Providence" automatic steam towing machine (Shaw & Spiegle patents) is described in circulars published by the American Ship Windlass Company, Providence, R. I. This towing machine is equipped with patent automatic guide rollers and independent warping ends. "It tows with a steel wire hawser which is carried on a drum geared to the engine. Under an increased strain the line pays out by overhauling the engine. This opens the automatic valve and admits more steam to balance the increased strain. A decreased strain allows the engine to haul in the line until the automatic valve again balances the steam pressure to suit the pull on the line. The tow line thus pulls against an automatic steam cushion which prevents its parting, no matter how sudden the shock. The machine also serves the purpose of a steam winch or hawser puller. It has reverse and throttle valves independent of the automatic towing valve, so that the line can be instantly reeled in or paid out, as desired. The drum stows all the line needed for towing, so that the deck is always clear. The patent automatic guide rolls move back and forth across the drum as required to lay the line evenly. It makes no difference how the line comes to the machine, it cannot pile up against the side flanges or damage itself in any way. These rolls are as strong as the machine itself, and dispense with the necessity of after towing bitts on a tug. The warping ends are keyed to an auxiliary shaft, which can be operated independently from the towing drum, by means of a clutch upon the crankshaft; this additional feature has all the advantages of a powerful steam gypsy without additional deck space. This towing machine is particularly adapted for use on tugs engaged in logging operations as well as other river tugs, as it does away with the tow line on the deck, storing the same all on the drum. The line can be paid out and shortened instantly by one man. It saves about 85 percent of the cost of manila hawsers."

Pneumatic and hydraulic riveters are described in bulletins published by the Hanna Engineering Works, 2905 Elston avenue, Chicago, Ill. "Hanna meters drive absolutely tight rivets with every stroke, because maximum pressure is reached at one-half piston travel and uniformly maintained throughout balance of stroke. No adjustment necessary for ordinary variations. You cannot obtain tight rivets without a known pressure. We give it to you. Obviates entirely the necessity of cutting out and redriving loose rivets. Reduces the cost of pneumatic hammer riveting fully one-half. A practical substitute for the hydraulic outfit at materially reduced initial cost. Hydraulic results guaranteed, due to the Hanna motion. It is distinct. Don't confuse it with any other. There is nothing else like it. Every riveter carries with it the guarantee of Hanna results. Any rivet user can tell you what that means. In asking for prices, etc., give reach, gay, size or rivets and class of work."

"The Cheapest and Safest Marine Power in the World" is the title of a catalogue published by the Marine Producer Gas Power Company, 2 Rector street, New York City. "To those who have not used our producer we will say that after over twenty years' experience of our engineers in the making of producer-gas plants and gas engines to the extent of over one hundred thousand of horsepower which are in successful operation, we have given our entire attention to the marine department for the last three years, and have perfected a successful and commercial gas producer which is simplicity itself and can be operated by any one with average intelligence. The weight and space necessary are very much less than that occupied by a steam plant. The weight of coal compared to gasoline for the same given number of hours run is but slightly more. The storage space will consequently be small, and in moderate-size plants, ranging from 25 to 200 horsepower, the coal can be cleanly and conveniently carried in bags and stowed in convenient places on the boat. Our suction producers, as herein described, use either anthracite pea coal, charcoal or coke, with equal power results. No changes whatsoever needed in the apparatus."

"Boiler Troubles and Their Prevention" is the title of a handsomely-printed pamphlet of 46 pages, a free copy of which will be sent to any of our readers who mention this magazine. This pamphlet is published by the Bird-Archer Company, 90 West street, New York, and should be in the hands of every engineer and shipowner. "The Bird-Archer Company guarantees, without conditions or reservations, where their compounds are used as directed: 1. To remove the oil, grease and scale from boilers and prevent the formation of new deposits. 2. That our compounds are absolutely uninjurious to steel, iron, brass fittings or packings; in fact, they act as a preservative to the metal parts and boiler accessories. 3. That our compounds will prevent pitting, grooving and corrosion. 4. That our compounds make unnecessary the use of zinc in boilers to prevent electrolytic corrosion. 5. That our compounds will not cause boilers to prime or foam, and that where these troubles now exist we can prepare a special compound to positively meet the need. 6. That our compounds will not 'cut' the cylinder lubricants. 7. That our compounds neither discolor nor contaminate in any way food products, beer, ice, bread, etc., where the live steam is used by the consumer in processing. 8. That if the above conditions are not fulfilled we will refund any money paid."

Holmes metallic packing is described in a catalogue of 40 pages published by the Holmes Metallic Packing Company, Wilkesbarre, Pa. "The Holmes patent improved metallic piston rod and valve stem packing is not a new metallic packing, but we are determined to supply the consumer with the best packing on the market, and at prices that will cause it to be used and its merit substantiated. This packing is in use on marine, stationary and locomotive engines, and is pronounced by expert engineers to be the best packing for the above purposes that has ever been put on the market. All mechanical engineers and engine builders acknowledge that a great loss of power is caused by friction on the rod, from the use of fibrous packing, or soft metal rings that are compressed on the rod by screwing up the gland so tight as to prevent the escape of steam. The use of fibrous packing also wears the rod out of round and uneven, and in some cases scores or scratches the rod or valve stem so that it necessitates its being taken out and turned, in order to keep it tight. There have been several metallic packings brought out which have had more or less merit, but Holmes' packing not only possesses all the merits of former productions, but is an up-to-date article, unexecelled in its wearing qualities, taking second place to none."

TRADE PUBLICATIONS

GREAT BRITAIN

Glacier anti-friction metal is described in circulars the Glacier Anti-Friction Metal Company, Ltd., 112a Queen Victoria street, London, E. C., is distrubuting. "This metal is now well and favorably known to the engineering trades throughout the world, and, without exaggeration, we think we can claim for it the largest sale of any registered brand on the market. It is suitable for bearings working under medium or heavy pressures, and it runs cool under the highest speeds. Its special advantages are its cool running properties, its low coefficient of friction, its absolutely uniform quality. We have received many flattering reports on the satisfactory working of this metal from several leading maritime powers, from leading railway and tramway companies, from large rolling mills and manufacturing engineers. These reports, as well as friction and and other tests, are embodied in our complete catalogue, which will be sent post free on application."

John Chapman & Company, 101 Leadenhall street, London, E. C., are distributing circulars describing Hall's "Skaylene," a composition that has been introduced for the purpose of doing away with the labor involved through the incrustation of boilers. It is prepared in the form of a black paint, and the statement is made that it preserves the interior of the boilers and steam tubes and also prevents the rusting of the boiler shell. It is said to be extensively used on board ship.

"Tauril" packing, made by Ferguson & Timpson, 6 Trinity Square, London, E. C., is described in circulars this firm is publishing. "As suggested by the title the name is derived from 'Taurus, a bull,' denoting the great strength of the material. It is made of a combination of pure rubber and asbestos, thus insuring great packing effectiveness with heat resistance. I am informed that three prominent shipbuilders, with testing appliances, have stated that they have found the Tauril packing to withstand the greatest strain of any packing they are acquainted with."

A marine ventilator is described in catalogues issued by H. D. Morgan & Company, 12 Jordan street, Liverpool. "This ventilator is designed on the principle that it is impossible to exhaust foul without supplying fresh air, and no matter which way the outside air is moving one portion of the ventilator is acting as an intake and displaces the foul air in the room, through the leeward ducts. The ventilation is instantly adjustable and is weather and spray proof; if it is left open one-sixteenth inch ventilation is not suspended, when closed it is watertight. We have a report from a yacht owner who has fitted a 3-inch (smallest size) on his yacht (she is about 2 tons); she sleeps two persons; previously to fitting she used to 'sweat' very much, and blankets and rugs were always more or less damp. Since the ventilator has been fitted all 'sweating' has disappeared, and blankets and rugs are quite dry. When sleeping on board, the yacht is altogether closed down and the ventilator left open. To use his own expression, before fitting they used to wake up with mouths like the bottom of a parrot cage; now everything is changed, and they wake up quite refreshed, and this with a 3-inch ventilator only. The ventilator is absolutely fool proof and soundly constructed with gunmetal nut and steel screw."

Marine boilers, light-framed compound engines for steam yachts, launches and tugboats; also high-class machinery for side of stern paddle-wheel vessels, etc., are the subject of circulars issued by W. Sisson & Company, Ltd., Gloucester. The following general description is given of this firm's compound non-condensing engines for stern-wheel steamers: "The engines to be of the stern-wheel type, consisting of two cylinders arranged according to our improved design, partially superposed, mounted upon steel girder framing, all self-contained and placed on the middle line of the vessel, driving two separate narrow wheels by means of cranks effectively at right angles and coupled by a drag link. This design takes up less room than the ordinary type, reduces the amount of steam piping and condensation loss somewhat, owing to the close proximity of the cylinders, and secures very clear way at each side of the wheels, while at the same time convenient access to crankpins is provided. The wheels being separated and brought nearer to the outer sides of the vessel are better supplied with water and thus are more effective, while the floats are not so large, and when damaged can be more easily replaced, and the floats on one wheel can be set intermediate with those on the other, causing more uniform action. Cylinders to be of special mixture cast iron, carefully bored and faced, and both fitted with piston valves, steam-stop valve, escape valves and drain cocks to be provided, and the passages to be so arranged that as far as practicable the condensation water shall run out of the cylinders readily as soon as the valves open the ports; to be carefully lagged with non-conducting composition and covered with blued sheet steel; pistons of cast steel for lightness, and fitted with packing rings of our special nickel-cast iron alloy, which is also to be used for the piston valve liners, which are forced into the cylinders and bored in place; piston rods of special steel about 37 tons tensile; guide bars of special steel, to be carried by the cylinders at one end and a motion plate at the other, securely attached to the steel girder framing; crossheads to be of cast steel, fitted with anti-friction bronze shoes; connecting rods of marine type, tubular for lightness, and fitted with anti-friction bronze bearings at each end; valve gear of single-fixed eccentric type, with all the working parts fitted with adjustable bearings or bronze bushes and reversed by handle and stop bar; wheel shafts of steel, and fitted with cast-steel cranks, the crankpins being separate, of special steel; wheel shaft outer bearings lined with white metal."

Folding lavatories for marine use are described in circulars published by J. Downton & Company, 71 West India Dock Road, London, E. The makers state that these lavatories are extensively used in steamships, launches, yachts, etc., in various parts of the world.

"Lion" packings are described in a catalogue issued by James Walker & Company, Lion Works, Garford street, West India Dock Road, London, E. These packings are made for all purposes—steam, hydraulic, ammonia, etc. "Lion" patent expanding metallic packing is stated to be the ideal packing for high-pressure steam work and high-speed engines. It is made with a channel or groove and with a corresponding tail, so that each successive turn fits into the other. This packing is automatic in its action, as the pressure finds its way into the channel or groove and causes it to expand. It is said to be made of the finest materials and has the metallic wearing face, thus reducing friction to a minimum.

Messrs. Crompton & Company (Ltd.) have issued a pamphlet giving particulars of the construction, output, prices, etc., of their enclosed motors and dynamos. The machines are made in five types, viz.: "protected," in which the end covers are open, but the working parts are protected from injury; "semi-enclosed," having perforated metal guards fitted over the openings in the end covers; "dust proof," containing two wire gauze guards, ¼ inch apart, over all openings; "pipe ventilated," or totally enclosed, having attachments for ventilating pipes for the circulation of air, and "totally enclosed," in which the ends are solid. The normal outputs of the machines range from 2 to 125 brake-horsepower. Pulleys, fly-wheels, couplings, field regulators and starters are also dealt with in the pamphlet.

"Non-conducting boiler and pipe coverings are described in a catalogue published by Matthew Keenan & Company, Ltd., Tredegar Road, Bow, London, E. "We respectfully invite attention to the various special and leading features of our composition and sectional coverings, etc., here embodied, which will enable intending purchasers to form some idea of the care bestowed by us upon our manufactures. For nearly fifty years we have been supplying the leading ship owners, engineers, railway companies, electric light and power companies, waterworks, brewing and distilling firms, laundries, etc., and the present large and continually increasing demand for our composition and other specialties is a conclusive proof of the high estimation in which our productions are held in all parts of the world. We can refer with pride and pleasure to the many large contracts executed by us, and the number of repeat orders which we constantly receive."

Merryweather & Sons, Ltd., Greenwich Road, S. E., and 63 Long Acre, W. C., London, have published a number of circulars describing fire boats which they have built for use in various parts of the world. One of the most interesting of these is a fire boat that was especially designed and constructed by Merryweather & Sons for the protection of the wharves and warehouses of the Rio Pinto Copper Mining Company, at Huelva, Spain. A seagoing boat was required with ability to start for a fire instantly at any time without power being constantly maintained. These needs were met by fitting the vessel with petrol motor engines, arranged to drive the propellers and the fire pump. The motors can be started instantly on an alarm; will then drive the boat to the scene of action, after which the power can be diverted to work the pumps. To give greater certainty in starting the motors and pumps are in duplicate and can be worked separately or together.

Boiler Scalers, Ltd., 111 High Park Road, Smethwick, have published a circular giving a photograph of a heap of scale which is said to have weighed 1,780 pounds, and which was removed from a 54-tube Babcock & Wilcox boiler by the "Anak" pneumatic tube scaler after other tools had failed.

Oil cans and oil economizers, oil fillers, bottles, glass lubricators, safety lamps, etc., are described in a very profusely illustrated catalogue published by Joseph Kaye & Sons, Ltd., Leeds. In addition to the large order for Kaye's patent serrated seamless steel oil cans for His Majesty's *Dreadnoughts,* more than 36,000 of these oil cans have been supplied to the British navy.

The indestructible combination washers made by C. A. Peters, Ltd., Derby, are described in a booklet which has just been published. The packing inside the ring gives a good bedding for any unevenness in flanges, and the middle casing prevents them from being blown out, so that they make perfect joints. The manufacturer states that they will stand any pressure and that they have been tested to over 2,000 pounds per square inch without giving way.

Babcock & Wilcox Company, Oriel House, Farringdon street, London, E. C., have published a catalogue describing their boilers, stacks, steel chimneys, water softeners, etc. The statement is made in this catalogue that over 1,800,000 horsepower of the marine type and over 7,600,000 horsepower of the land type of Babcock & Wilcox boilers are now in use.

Storm proof flare lights, hand lamps, etc., are the subject of an illustrated catalogue just published by Imperial Light, Ltd., 123 Victoria street, London, S. W. A list is given of a few of many thousand users of "Imperial" lights, among them being the British Admiralty, a large number of the leading shipbuilders and owners of the world, many prominent rail-

Messrs. Lobnitz & Company, Ltd., of Renfrew, Scotland, have issued an excellent album of illustrations of their works and some of their recent productions. The latter include bucket and suction dredgers, clay-cutting dredgers, gold dredgers, rock-cutting vessels, hopper barges, steam tugs, stern-wheel steamers, etc. One of the bucket dredgers illustrated is stated to be the largest afloat. It was built for the Suez Canal Company.

Messrs. John Lysaght Ltd., of Bristol, have published an excellent album containing a large number of views of their Netham iron works, and also constructional steel work they have carried out in various parts of the world, including bridges of all types, machine shops, oil tanks, steel roofs, etc. At the end of the book are given illustrations and dimensions of standard and special sections of the galvanized corrugated sheets which they make at their St. Vincent's iron works. This information, it is stated, has never been compiled before, and it should prove useful to engineers in drawing up specifications that involve the use of this material.

The Grille watertube boiler for marine and land installations is described in an illustrated circular distributed by the British Grille Water Tube Boiler Company, Craven House, Kingsway, London, England. "For marine work the boiler is particularly suitable on account of the small floor space, cubical measurements, weight and high evaporation. By reference to the list of installations it will be seen that these boilers have been installed on several well-known ships, among which may be mentioned the *La Provence* and the cross-channel boat *Pas de Calais* and her sister ship the *Nord*."

Iron and steel tubes and fittings of every description are the subject of a profusely illustrated catalogue of 80 pages published by John Spencer, Ltd., Wednesbury.

Worthington pumping machinery is described in a new list published by the Worthington Pump Company, Ltd., 153 Queen Victoria street E. C., and gives full details of pumps for all services. Many different patterns of boiler feed pumps are dealt with, also fire pumps, pumping engines, hydraulic pressure pumps, etc.

"Sarco, a Bulletin of Power Plant Practice," is published by Sanders, Rehders & Company, Ltd., 108 Fenchurch street, London, E. C., and is intended primarily to keep power plant owners posted as to the latest developments and applications of "Sarco" apparatus, such as combustion recorders, recording steam meters, indicating draft gages, recording draft gages, feed-water analyzers, gas volume recorders, etc.

Maschinenfabrik Augsburg-Nürmberg, A. G., Caxton House, Westminster, S. W., is distributing circulars describing "Nüremberg" oil engines for marine purposes. Among the special features claimed for these engines are perfect maneuvering power, direct reversing and alteration of speed being effected by a single lever, the engine being reversed in a few seconds from full speed ahead to full speed astern; light weight, low consumption of fuel and great reliability.

The Beldam Packing & Rubber Company, 93 and 94 Gracechurch street, London, E. C., has published circulars describing its packing for all purposes. This company are contractors to the Admiralty and to many of the leading steamship companies of the world, such as the White Star Line, the Red Star Line, the Atlantic Transport Company, the American Line, the Leyland Line, the Anchor Line, the Nippon Yusen Kaisha and many others.

Royles, Ltd., Irlam, near Manchester, have published a large number of circulars dealing with steam specialties, such as evaporators (for feed make-up), condensers (surface and fresh water), air heaters, boiling batteries (superior to coils in any form), steam kettles, radiators, gas boilers, boiler mountings, steam traps (syphonia system), steam traps (expansion type), steam dryers, compound steam traps, return steam traps, reducing valves, surplus valves, safety and relief valves, swivel unions and bends, hydraulic test pumps, asbestos packed fittings, gunmetal steam fittings, grease separators.

BUSINESS NOTES

AMERICA

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York, has recently opened new branch offices in Atlanta, Ga., and Rochester, N. Y. The Atlanta office is located in the Empire building, in charge of Mr. W. F. Johns, and the Rochester office is located at 725 Chamber of Commerce, in charge of Mr. H. P. Domine.

LIGHT DRAFT STERN-WHEEL STEAMERS are a specialty of the Willamette Iron & Steel Works, Portland, Ore. This concern has built the following boats: Alaskan rivers, *Koyukuk; Tanana, Delta, Reliance, General Jacobs, Chitna, Tasnuna, Alice;* Puget Sound, *S. G. Simpson;* Pend d'Oreille, *Ione;* Coeur d'Alene, *Harrison;* Columbia River, *Dalles City, Nestor, Kellogg, J. N. Teal, Inland Empire, Twin Cities, Umatilla.*

DIXON'S POWDERED FLAKE GRAPHITE.—While the Joseph Dixon Crucible Company, Jersey City, N. J., is the oldest and largest graphite concern in the world, there are no doubt many more or less recent users of graphite who may not be fully acquainted with its line. "It was Dixon's flake graphite that first made graphite lubrication practicable. The name Dixon has always been associated with flake graphite, and it is flake graphite alone that the Dixon Company provides for lubrication. The flake form makes 'balling up' in cylinders absolutely impossible. The word flake seems to give some the impression that the Dixon graphite is coarse. It is true that a large flake graphite known as Dixon's No. 1 is prepared, but in addition to this there are two finer grades, that known as No. 2 and that indicated by the number 635. This last, while a flake graphite, is ground to an impalpable powder. Under the microscope its flake formation is evident, but to the naked eye the flakes are not appreciable. The No. 2 graphite is about one-half way between the No. 1 and No. 635. These three grades (referring to size of flake) cover every lubricating requirement that occurs in the power house and machinery field, from heavy, slow-moving bearings to the very finest and closest set ones. The Dixon Company is always glad to take up the lubricating problem with any who may desire to avail themselves of Dixon's wide experience."

A FIBROUS SHEET PACKING suitable for every condition in the engine room. "Vanda packing, made by Vanda Company, 96 Spring street, New York, was invented and perfected by a chemist who originated fibrous packings, and is the highest developed form of fiber packing made. It is composed of fiber selected for its peculiar indestructibility when subjected to conditions of heat or acid, and of a special composition of gums, oils and graphite. Vanda is not constructed after the manner of the earlier forms of fiber packing placed on the market, as it is made without distinct cemented laminations, which are found in substitutes and imitations. Vanda will resist the highest temperatures and is not affected by saturated steam under low temperatures or otherwise, and is adapted for not only superheated steam but saturated steam, hot and cold water ammonia, acids, etc., therefore can be used more universally and under more varied conditions than any other form of joint packing. Vanda possesses many advantages, chiefly among which are the following: When applying Vanda it does not soften up under the action of heat, consequently will not crawl or shrink. Vanda also conforms to imperfect or rough surfaces and seats to better advantage, keeping the joints tight and in better condition than is possible with corrugated copper gaskets, and if once properly applied in the joint will last indefinitely under normal conditions. For steam purposes where the flanges are smooth or faced Vanda can be used in one-half the thickness of rubber packings. Vanda is lighter in weight per square yard, or per square foot, than any rubber packing on the market. Vanda is superior to metallic gaskets, which corrode or oxidize under conditions of high temperature and chemical conditions of water from condensation. Vanda is thoroughly impregnated with graphite, which does not mix with water, hence is unaffected by saturated steam, water, ammonia, etc.; and is, therefore, superior to all red, white, marbleized fibrous sheet packings, which contain magnesia, oxide of iron, or other minerals which readily absorb water, and are, therefore, unsuitable as joint packings where there is a possibility of condensation settling in the joints, which is a common occurrence. Vanda packing does not deteriorate, and may be carried in stock in the engine room indefinitely, as it does not become hard or brittle like other packings made in imitation of Vanda. While Vanda packing may be used one-half the thickness of rubber packings for

steam purposes where the flanges are smooth or faced, if the flanges are rough it is advisable to use the same thickness of Vanda packing as you would of rubber packing. It is also advisable under ammonia, air or cold-water conditions to use the full thickness, 1/16 inch thick being the size mostly used for these conditions. Vanda packing can be used successfully for hot or cold water, air, ammonia, gas, superheated or saturated steam under either low or high-pressure. Vanda packing possesses many advantages over all forms of asbestos packing or asbestos metallic wire cloth, as these forms of packing, where there is condensation, eventually disintegrate, or the asbestos pulps around the wires, allowing the steam to eat its way through gradually, leaving nothing but the wire when a blow-out follows. Vanda is made without wire, and when properly applied will last indefinitely and will not blow out. While Vanda packing is not recommended for all types of gas engines to have advantage over asbestos metallic wire cloth packings on the Otto gas engine and many other types, it has given better results than any other type of packing. For this service, under normal conditions, nothing heavier than 1/32 inch should be applied."

THE AMERICAN BUREAU OF SHIPPING, 66 Beaver street, New York, in the *Record of American and Foreign Shipping,* has recently classed and rated the following ships: American screws, *City of St. Louis, Theodore H. Wickwire, Jr., Brooklyn, H. F. Dimock, Newport;* American schooners, *Sadie C. Sumner, Daylight, Donna Christina, Henry W. Cramp, Massasoit, Laura L. Sprague, Henry Crosby, Brookline;* American brig, *Number Eight;* British schooners, *Seth, Jr., Gypsum Emperor.*

EIGHT THOUSAND PER CENT FASTER.—Referring to the advertisement of the Marine Iron Works, 2036 Dominick street, Chicago, Ill., on the front cover of this issue, in which the stern-wheel steamer *B X,* built by the Marine Iron Works, is shown climbing Fort George Cañon in three minutes. The builders write us that the steamer is able to go through this cañon in *three minutes,* although the best previous record was *four hours,* because all previous steamers had to be helped through the cañon by the use of lines and steam capstan, practically pulling themselves the entire distance. The *B X,* we are told, is able to go through the cañon under her own steam without using or wetting the line, or having any sort of assistance in this particular part of the trip.

FORCED DRAFT FOR TORPEDO BOAT DESTROYERS AND BATTLESHIPS.—Great interest has been shown over the recent adoption by the United States navy of fuel oil in place of coal. The first of the oil-burning type of torpedo boat destroyers, the *Roe,* was turned over to the government for first trial on July 14, 1910. In the specifications the vessel was to make 28 knots on her trial trip. She made 31 knots. Great interest is said to have been taken by naval engineers in the "Sirocco" forced draft fans made by the American Blower Company, Detroit, Mich. Those on board the *Roe* are 30 inches in diameter; but we are told that they supplied 23,000 cubic feet of air per minute at 5 inches watergage pressure. The American Blower Company also supplied twenty-eight "Sirocco" fans for each of the recently-tested and accepted battleships *Delaware* and *North Dakota,* and the *Florida* and *Utah* are also being equipped both for mechanical draft and ventilation with fans of the same manufacture.

NEW FACTORY.—The United States Indestructible Gasket Company, Hudson Terminal, No. 50 Church street, New York, is building a new plant in Brooklyn, N. Y., which will have a space for machines equal to 10 feet wide by 500 feet long. The building is of semi-fireproof construction, steel sash being used, and well lighted. This new plant afforts greatly increased facilities for the manufacture of its products, consisting of gaskets, washers, discs, rings, diaphragms, stampings, formings, punchings, dies, multiple-disc pump valves and specialties of all kinds, including corrugated, flat and grooved copper, lead, steel, bronze, indestructibleite, Ames' alloy, Norway and Swedish iron, monel metal, sparkite, copper-asbestos, wire, paper and other gaskets; also washers, discs and rings of any metal, fiber, asbestos, leather, cork, mica, rawhide, felt, canvas, etc., of every size, shape and thickness. Among the company's well-known specialties are Sparkite Gaskets and Sheet, which stand extreme heat and flame, designed particularly for spark plugs; Seamless Tubular Pneumetalastic Gaskets, which are ideal for flanged water, oil and gas pipe lines; Ames' Alloy H. P. Sheet Packing and Gaskets, a superior substitute for rubber and asbestos packings and gaskets; Saunders' Pattern Grooved Copper Packing and Gaskets.

BUSINESS NOTES

GREAT BRITAIN

BOWESFIELD STEEL COMPANY, LTD., 110 Cannon street, London, E. C., has been awarded a gold medal for its exhibit of steel sheets, black and galvanized, plain and corrugated, and accessories, at the Japan-British Exhibition.

MESSRS. RAILTON, CAMPBELL & CRAWFORD have equipped the Cunard liner *Franconia* with their patent furnace bars, together with five of their patent water filters, and also two ash-hoist installations. This firm have also secured a like contract for the sister ship *Laconia*. These specialties will also be supplied to the two leviathan White Star liners *Olympic* and *Titanic*, now building at Belfast.

THE ENGINEERING WORKS of the London & Glasgow Shipbuilding & Engineering Company, Ltd., at Lancefield, have been considerably extended. A new machine shop, measuring 200 feet by 50 feet and 60 feet high, was added to the existing shops of the company some little time ago by Sir William Arroll & Company, Ltd. Alongside, a new shop of the same dimensions, to be entirely devoted to erecting purposes, has now been completed. The latter, while of the same general style of construction, has been erected by Messrs. A. & J. Main and Arroll's Roof & Bridge Company, Ltd. In line with the new erecting shop, although not so high, a new pattern shop has also been constructed. For a depth of 40 feet from the eaves the enclosing walls of the new shops are of galvanized corrugated iron, the remainder, to the concrete foundations, being brickwork. Electric overhead traveling cranes of 50 tons capacity serve the machine shop, while the crane girders of the new erecting shop are designed to carry two traveling cranes, each to lift 60 tons. Electric driving has been provided for all the new and most of the existing high-calibre tools, and amongst the new machines laid down are several specially designed to deal with turbines of the larger sizes now common in naval ships. These include a turbine casing boring machine and a turbine rotor lathe, both motor-driven and capable of dealing with turbines up to 16 feet diameter. These are of Messrs. Thomas Shanks & Company's make, the lathe being of 120 tons weight and laid upon specially strong foundations of reinforced concrete. Wall and table vertical and horizontal planing machines, slotting and drilling machines, have also been installed.

CLARKE, CHAPMAN & COMPANY, LTD., Gateshead-on-Tyne, have recently received some large and important orders for Woodeson patent watertube boilers, one of them being from the generating station at the Devonport dockyard, this being a repeat order for the same type of boiler received from the government last year.

MR. W. P. BUTTERFIELD, Shipley, Yorks, manufacturer of rectangular and circular tanks for gas and oil engines and for ice, writes INTERNATIONAL MARINE ENGINEERING: "I beg to inform you that I have converted my concern into a private limited company, with a capital of £30,000, of which shares are being taken up by my leading employees, so that they will have a more direct interest in their work beyond their weekly wages, and this will, of course, mean better workmanship and prompter deliveries. My works have considerably increased in size, and are fitted out with the best and most modern plant that money can buy, so on this account we can defy the keenest competition. The style of firm to be 'W. P. Butterfield, Ltd.,' to whom all checks must be made out and all communications addressed; and please note, no outside capital has been subscribed, and Mr. W. P. Butterfield acts as sole managing director."

CORK MATTRESSES FOR SHIPS AND YACHTS are made by Leoline Edwards, 19 Ailsa avenue, St. Margaret's-on-Thames. "In examining this cork and comparing it with virgin cork under the microscope, the cells are found to be double the usual size, it has become much softer and more resilient, resembling rubber in this respect, and this latter quality can readily be tested by pressing a few granules between the finger and thumb. It is only half the weight of ordinary cork; does not absorb so much water and is supplied in a granulated form, the mattress or cushion being filled with same. The ship or yacht mattress is made with an inner case, divided into compartments, in which the cork is packed and securely retained; this inner case is then enclosed in an outer tick, which is laced at one end. This arrangement allows of the whole mattress being thoroughly cleaned at any time by anyone, as the inner case, by undoing the lacing, can be withdrawn and soaked in water or disinfecting fluid, or played on by water from a hose pipe, and then hung over a line to dry; it can also, if necessary, be baked in an oven, as the cork is not affected injuriously through these processes. The outer case or tick is washed in the usual manner and put over the inner one, and so on."

J. W. Brooke & Compan, Ltd., Lowestoft, have built for the Société des Nouvelles Vedettes a fleet of ten passenger motor boats, eight of them being 42 feet 7 inches long and the other two being 60 feet long.

Hydraulic Gear.—Powerful and complete installations of hydraulic gear for steering the two mail and passenger steamships for the Peninsular & Oriental Company, which have been built by Messrs. Caird & Company, Greenock, and for working the cargo, etc., are being provided by Messrs. Brown Bros. & Company, of Edinburgh.

It is seldom that one firm is entrusted with the order for as many as ten vessels for any navy, but, as is well known, Messrs. Yarrow & Company, Ltd., Scotstoun, Glasgow, have recently received an order from the Brazilian government for ten torpedo boat destroyers. These destroyers are all to be of one design, and they will partake generally of the characteristics of the British "River" class.

A new form of coupling for hose pipes has been introduced by Messrs. Siebe, Gorman & Company, Ltd., of Westminster, London, S. E., and known as the "Dazol." The union is effected by inserting the tenons of one part into slots provided in the other, the two parts being given one-fifth of a turn, tightened with one turn of a nut. It is claimed that with this form of coupling, which is also applicable to other forms of apparatus, connection may be made by hand in any position, and that the joint cannot become unscrewed by the vibration of engines, etc.

The Cambridge Scientific Instrument Company, Ltd., have developed a large sliding microtome for cutting flat sections up to 150 by 120 millimeters; a sliding carriage, which supports the object-holder and feeding mechanism, rests at three points on two guides in the frame of the instrument. The whole carriage can be moved backwards and forward on these guides by means of the handle working through levers. After the cutting stroke has been made, and when the carriage has nearly reached the extreme position, a stop pin, operating through a ratchet, turns a toothed wheel and screw and feeds the object-holder upwards. On the return stroke the mechanism causes that part of the sliding carriage which holds the object-holder to drop just before it reaches the knife, and to rise after passing the knife to its former position in preparation for the next cutting stroke.

It has been decided by the National Scottish Exhibition, in view of next year being the centenary of the building of the steamship *Comet* at Port Glasgow—although her actual launch and start in river service did not take place till early in the year following—to celebrate the event by a display on the River Kelvin of the successive types of ship used in Scottish waters from the earliest times to the present day. Some twenty-three vessels, represented by models worked by operators inside or underneath the floating model, will sail in procession down the Kelvin on the opening day of the exhibition, the types varying from the "dug-out" canoe of the early Britons of Strathclyde, the Roman war galley of Cæsar and Agricola, and the coracle in which St. Mungo's mother was set adrift in the Forth, to the *Comet*, the *Rob Roy* (the first ocean-going steamer), and the present-day *Mauretania* and *Dreadnought*.

Porhydrometer, Ltd., 6 Lloyd's avenue, London, has published an illustrated circular describing the porhydrometer, which "is an extremely simple adaptation of the laws of nature governing displacement and water level, and can be fitted to any vessel from the ordinary barge to the largest liner. It really is an indicator of the vessel's own displacement, and virtually turns the ship to which it is fitted into a weighing machine. It consists of a small steelyard of simple pattern attached to an aerometer or float, which measures accurately any alteration in displacement due to weight placed on or removed from board. The aerometer is placed in the center of the vessel and suspended inside an iron pipe, into which the sea water has free access and rises to a level corresponding to the draft of the ship. When the steelyard is balanced the aerometer is always in its normal position and displacing an amount of water exactly in proportion to the weight resting on the ship. The pipe only need extend a little way below the light waterline of the ship and its sea connection is very small, a cock of 1 inch diameter being quite sufficient for the largest vessels. The whole apparatus does not occupy much space, and its weight, all told, will vary from about two to six hundredweight. The outer pipe is about 6 inches diameter, and is no more cumbrous than an ordinary hold stanchion. It is strongly made in order to resist battering from cargo. The case containing the steelyard is about 3 feet 6 inches long, 1 foot 6 inches high and 8 inches broad. It can be placed in the most convenient position above deck. The trim of the vessel, whether she is lying on an even keel or not, does not affect the accuracy of the porhydrometer."

MARINE SOCIETIES.

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS.
Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
814 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
Naval Academy, Annapolis, Md.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS.
5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.
39 Elmbank, Crescent.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORP.
58 Romford Road, Stratford, London, E.

GERMANY.

SCHIFFBAUTECHNISCHE GESELLSCHAFT.
Technische Hochschule, Charlottenburg.

MARINE ENGINEERS' BENEFICIAL ASSOCIATION

NATIONAL OFFICERS.

President—Wm. F. Yates, 21 State St., New York City.
First Vice-President—Art Hyde, 9115 Willard Ave., N. W., Cleveland, Ohio.
Second Vice-President—Wm. P. Tindall, 180 Twentieth St., Detroit, Mich.
Third Vice-President—Charles N. Vosburgh, 6323 Patton St., New Orleans, La.
Secretary—Geo. A. Grubb, 1040 Dakin St., Chicago, Ill.
Treasurer—A. L. Jones, 38 Avery Ave., Detroit, Mich.

ADVISORY BOARD.

Chairman—Frank J. Houghton, Port Richmond, S. I., N. Y.
Secretary—Wm. L. Bridges, 784½ Twelfth St., Milwaukee, Wis.
John A. Watts, 318 Fifth St., S. E., Washington, D. C.

AMERICAN ASSOCIATION OF MASTERS, MATES AND PILOTS.

NATIONAL EXECUTIVE COMMITTEE.

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National First Vice-President—Wm. A. Westcott, 1 Ferry Building, San Francisco, Cal.
National Second Vice-President—A. R. Mackey, 8 Wood St., Pittsburg, Pa.
National Third Vice-President—Charles Davis, St. Louis, Mo.
National Treasurer—A. B. Devlin, 21 State St., New York. Also secretary pro tem.
National Counsel—L. B. Dow, 21 State St., New York.

The contract for the electrical equipment of the Cunard steamship *Franconia* was secured by Messrs. William C. Martin & Company, of Glasgow. The installation comprises about 3,000 electric lights, in addition to electric bells, fans, radiators, motors, telephones, clocks, searchlight and other appliances. Current will be supplied by three compound engines and dynamos, each of 130-kilowatt capacity. The same firm have also received a contract for the similar equipment of the sister ship *Laconia*, and other work now being executed by them includes electrical installations for the steamships *Cameronia*, of the Anchor Line; the two steamships, the *Inventor* and *Explorer*, for the Harrison Line, of Liverpool; several of the new steamers recently ordered for the British India Steam Navigation Company, a large passenger liner for Italian owners, and other vessels, the total amounting to over 2,000 horsepower.

Machines Used on Shallow-Draft River Boats.—Among the numerous specialties of this sort built by the American Ship Windlass Company, Providence, R. I., are single and double-barrel steam capstans, steam gypsies, dock steam capstans, hand-power capstans operated by cranks, caval capstans, ratchet capstans, gypsy windlasses and warping winches, towing machines and anchors.

TRADE PUBLICATIONS.

AMERICA

The Reilly multi-coil feed-water heater is described in a catalogue published by the Griscom-Spencer Company, 90 West street, New York. The statement is made that the use of this heater will save at least 10 percent of your coal bills, and that this saving will pay for the heater in a short time.

A grease-extracting feed-water filter for marine and stationary engines is made by the American Steam Gauge & Valve Manufacturing Company, Boston, Mass., and is described and illustrated in a catalogue that company has just published. Among the advantages claimed for this feed-water filter are that it has a filtering surface equal to 320 times the area of the feed-water pipes; that it has the simplest and quickest of all methods of making renewals; a device for applying a reverse current of steam and making temporary cleaning. It is light, but strong and durable; easy and quick to clean; cheap to maintain; economical of space; simple in design, moderate in cost. Filters are furnished in cast iron or bronze. An extra set of cloths is furnished with each filter.

Valves of many types, oil pumps, sight-feed oilers, injectors, and many other marine steam auxiliaries are described in illustrated circulars published by the William Powell Company, Cincinnati, Ohio. For this company's "Cyclone" blow-off valve the claim is made that its construction is so simple that it enables the engineer to adjust the valve at any time with an ordinary monkey wrench, a great convenience when it needs repacking. The disc and seat bearing are constructed with such a large angle that it is impossible for any sediment or scale to lodge between them, either while blowing off or closing the disc, so that they are not worn out after a few months of use. Every valve is tested to 250 pounds hydraulic pressure. The William Powell Company's improved screw-feed grease cup is especially designed for marine engines, and where it is desired to force the grease some distance, as in air compressors, ice machines, etc. It is said to be particularly desirable for intermittent or positive feed.

Another edition of the "Smooth-On Instruction Book" has just been issued by the Smooth-On Manufacturing Company, 572 Comunipaw avenue, Jersey City, N. J. This book tells all about Smooth-On iron cements, sheet packings, corrugated metal gaskets, and shows when, where and how to use them. "The great value of Smooth-On to the manufacturer and user is because of its peculiar chemical properties, namely, of metalizing and of expanding when metalizing, and it can be prepared to act quickly or slowly, according to the requirements of particular uses. These properties make Smooth-On a valuable substance in the making of chemical iron cements. To this subject the chemist of the Smooth-On Manufacturing Company has given careful study for fifteen years, and has succeeded in compounding the valuable iron cements known so generally throughout the world as Smooth-On iron cements. These cements are made each for a special purpose; they are carefully prepared by a chemist, and when correctly used they make permanent repairs. The different Smooth-On cements are explained in the following pages; a careful study of them will prove interesting and profitable. The illustrations are made from photographs of actual subjects, and show some of the many ways in which the Smooth-On cements have been used and the results obtained."

Pneumatic Tool Catalogue No. 32 has just been issued by the Chicago Pneumatic Tool Company, Fisher building, Chicago. This catalogue is handsomely printed and profusely illustrated. It consists of 104 pages and lists a complete line of pneumatic tools and appliances, air compressors and "Duntley" air-cooled electric tools. This catalogue is offered to customers in order to put before them the company's standard lines of pneumatic tools and appliances, together with specialties which have been devised from time to time for special purposes in order to meet the requirements of the trade. In connection with this, the company invites inquiries from those interested concerning the adaptability of pneumatic tools and appliances to new uses; it being understood that the Chicago Pneumatic Tool Company is willing at all times to furnish information or to undertake new commissions where conditions permit of success. This company publishes many more catalogues, any one of which will be sent free to our readers who will mention this magazine. Among these catalogues is one describing "Franklin" air compressors, which are made in more than one hundred styles and sizes, and a catalogue of air-cooled "Duntley" electric tools (drills for direct and alternating current, all sizes of voltages, grinders, blowers, buffers, hoists).

The boat oars of every description made by the New York Boat Oar Company, 69 West street, New York City, are described in an illustrated catalogue this company has issued. Among the various kinds of oars illustrated are ash sculls and oars, copper-tipped ash sculls, spruce sculls, spruce and ash sculls, spoon sculls and spoon oars, canoe paddles of various types, etc. In addition to this handspikes, capstan bars, mast hoops, etc., are illustrated.

"Cast Steel Valves and Fittings" is the title of special catalogue No. 70 issued by Crane Company, Chicago, Ill. This is a profusely illustrated volume of 64 pages, and "represents a line of cast steel valves and fittings which we have been manufacturing for some time to meet a steadily growing demand for a superior grade of goods, especially adapted for high-pressure, saturated and superheated steam lines of extreme hydraulic service."

Do you want to know about improvements in hydraulic punches? If so, write to the Watson-Stillman Company, 188 Fulton street, New York, and ask for a copy of Catalogue No. 77. Its pages list many new tools never before described, and also older types of punches and shears that have proved useful. Every shop superintendent, manager or foreman using hydraulic power for metal punching and shearing can profit by reading this catalogue carefully, for the tools described can handle a wide variety of work on sheet metal, bars, rolls, structural iron, etc.

"Fine Mechanical Tools" are the subject of Catalogue 19-L, just published by the L. S. Starrett Company, Athol, Mass. This catalogue has 274 pages, 42 more than were in No. 18-L, and there are over 350 illustrations. It should be in the hands of every user of mechanical tools or instruments of precision, and a free copy will be sent to any of our readers who will mention this magazine. An almost infinite variety of tools is described and illustrated, a few among them being micrometers, calipers, squares, protractors, levels, steel rules, indicators, hack saws, speed indicators, dividers, etc.

Turbo-Generating Sets.—Bulletin No. 176-O, published by B. F. Sturtevant Company, Hyde Park, Mass., gives full information regarding Sturtevant turbo-generating sets, which are stated to possess all the general advantages of steam turbine units, such as requiring no special foundation, very little attention necessary, no oil in the exhaust steam, and, in addition, to be of comparatively low speed, greater durability and simplicity, to have indestructible pockets and large clearance between casing and disc. They are said to occupy less space per horsepower than any other slow-speed turbines.

Marine Steam Driers.—H. & B. steam driers, sold by E. C. Garratt & Company, the sole distributors, 640 Singer building, New York, are said to be extensively used on board ship, and in circulars distributed by Garratt & Company are reproduced a number of testimonials from chief engineers. Among other instances of economy produced by the use of this drier the following is given: "The Matson Navigation Company's steamer *Lurline,* running between San Francisco and Honolulu (oil fuel), consumed 375 barrels per day after installing the H. & B. patent steam drier, against 405 barrels previously, besides developing 200 additional horsepower."

"The Book of Hoists" will be sent free upon application to the Yale & Towne Manufacturing Company, 9 Murray street, New York, to any of our readers mentioning this magazine. Among the numerous uses to which chain blocks may be put is taking off a cylinder head: "When you want to take off a cylinder head, and the working space is small, the head room low, temperature high, and everything at a standstill, waiting for you to do the job, there is no helper like a triplex block. A little pull at the hand chain lifts it clear as soon as you have loosened the nuts, a reverse pull on the hand chain drops it into place as soon as your work is completed."

Lunkenheimer steam specialties are the subject of a great number of catalogues and booklets issued by the Lunkenheimer Company, Cincinnati, Ohio, any one of which will be sent free upon application to readers mentioning this magazine. Among the catalogues this company issues are those with the following titles: "Generator Valves," "Safety Valves," "Oil Cups," "Exhaust Pressure Regulators," "Safety Water Columns," "Automatic Injectors," "Automatic Cylinder Cocks," "Mechanical Oil Pumps," "Blow-Off Valves," "Specialties for Traction or Portable Engines and Boilers," "Regrinding Valves," "Sand Blast and Air Nozzles," "Grease Cups for Cylinder Lubricators," "Oiling Devices," "Whistles," "Ground Key Work with Special Keys," "H-W Cross-Head Pin Oiler," "Specialties for Automobiles and Motor Boats."

Micrometers for Engine Shops.—The Brown & Sharpe Manufacturing Company, Providence, R. I., has placed on the market a set of micrometers that should be in every marine engine shop. They range from 1 to 12 inches, thus having capacity sufficient for almost all kinds of marine work. Upon application, the Brown & Sharpe Manufacturing Company will send a circular giving full list of prices.

Bulletin No. 121, published by the Elliott Company, 6907 Susquehanna street, Pittsburg, describes "Elliott" steam traps. "The advantage of the Elliott steam trap is that it always discharges the water at 212 degrees F., whereas all other traps discharge the water at boiler pressure, or at the pressure of the vessel from which it is being discharged. This results in a large loss of heat units."

For shipyards and repairs aboard ship "A B C" electric forge blowers save time, as other work can be completed or started while irons are heating. They require no attention, and are started and stopped by a switch handily located. The blast is strong and positive. The manufacturer, the American Blower Company, Detroit, Mich., states that they cost less than 5 cents per day each for electric current to operate.

"Producer Gas for Power and Fuel" is the title of a pamphlet issued by the Syracuse Industrial Gas Company, Vernon, N. Y.

Sheet 77-A, published by Williamson Bros. Company, Philadelphia, Pa., describes a hawser puller for limited space at a low price. It is made in several sizes, is compact, takes up very little deck space and requires no room under deck.

Steel dredges are described in circulars issued by the American Steel Dredge Company, Fort Wayne, Ind., and are stated to combine great capacity with effectiveness, lightness, portability, strength, ease and low cost of operation.

A free copy of Catalogue No. 12, just issued by the Michigan Lubricator Company, Detroit, Mich., will be sent to any of our readers who will mention INTERNATIONAL MARINE ENGINEERING. This is said to be a very complete and valuable volume.

Marine oil engines, from 1 to 400 horsepower, are described in a catalogue issued by A. Mietz, 130 Mott street, New York. Mr. Mietz states that more than 100 horsepower of his engines are now in operation, using kerosene, fuel oil, crude oil and alcohol.

Lubrication troubles of many kinds may be cured by the use of Dixon's flake graphite. Unlike oil, it is said that Dixon's graphite will not injure boilers if it reaches them. A free sample of this graphite and a copy of Catalogue 75-C will be sent to any of our readers upon request.

The "Ideal" automatic pump governor is described in a catalogue published by the Ideal Automatic Manufacturing Company, 125 Watts street, New York. This pump governor is said to be the only marine pump governor on the market, and is guaranteed to work on salt water or any other fluid leaving a deposit. It has been approved by the Steamboat Inspection Department.

TRADE PUBLICATIONS

GREAT BRITAIN

Messrs. Webster & Bennett, Ltd., Atlas Works, Coventry, have recently issued two catalogue sections, one dealing with horizontal boring and milling machines, and the other with multiple-drilling machines. The horizontal boring and milling machines are manufactured by the Werkzeugmaschinen-Fabrik Company, of Chemnitz, in three types, the vertical adjustment is effected in two of these by moving the table and the boring spindle, respectively; the transverse and longitudinal movements of the work are obtained in both by moving the table. In the third type the work is bolted to a fixed table, and the spindle, which is carried on a vertical column, is movable in all directions. The catalogue gives particulars of machines of several sizes in each type. The multiple-drilling machines are of Messrs. Webster & Bennett's own make, and the catalogue gives full particulars of two and four-spindle machines for drilling, boring and tapping, a duplex horizontal drilling and tapping machine, single-spindle sensitive drilling machines, and other tools.

"Marine Gas Engines" is the title of a booklet published by the Holzapfel Marine Gas Power Company Syndicate, Ltd., 57 Fenchurch street, London, E. C. The directors of this company have for several years past followed the development of gas power with the greatest interest, having in view its adaptation to marine purposes. The power gas plant at the works of Holzapfels, Ltd., at Newcastle-on-Tyne, is stated to have worked without a hitch for five years, producing gas at the cost of ¾ pound of bituminous coal per indicated horsepower per hour, and this fact convinced them of the great economical feature of gas power in connection with shipping. After various attempts to obtain a reversible gas engine they came to the conclusion that in the present development of engineering reversible gas engines would not give reliable and satisfactory results, and that an intermediate mechanism was absolutely essential. When Prof. Föttinger, of Stettin, described his invention of the hydraulic power transformer they realized its suitability for internal combustion engines, and secured from the Vulcan Company, of Stettin, the patent rights, so far as gas engines are concerned. This transformer is stated to have many advantages compared with electricity, and its action is said to be almost instantaneous and considerably more rapid than that of steam engines. Having secured the British patent rights for this transformer, the directors constituted the present company and ordered a small trial vessel, the *Holzapfel I.*, which will be the first sea-going gas-driven cargo vessel afloat. A description of this vessel and her gas plant is included in this pamphlet.

The Ozonair system of ventilation is described in a circular published by Ozonair, Ltd., 96 Victoria street, Westminster, London, S. W. The system consists in drawing the air supply from as clean and pure a source as possible and removing the smuts and other solid floating matter by means of one of the special filtering screens manufactured by the company. This system of ventilation is said to be especially suitable for use on board ship, and the T. S. S. *Makure*, belonging to the Union Steamship Company, of New Zealand, is equipped with the Ozonair apparatus.

B. R. Rowland & Company, Ltd., Climax Works, Reddish, have issued an illustrated catalogue of emery and corundum grinding wheels and machines. The machinery illustrated is divided into four sections, as follows: (1) Dry grinding machines and face-wheel machines; (2) tool grinders and twist drill grinders; (3) woodworking tools and saw sharpeners, knife and cutter grinders, internal plain and cylindrical grinders, and (4) roll grinders, disc and portable grinders and polishing lathes. The book is extremely well got-up, and contains useful information for buyers.

The British Thomson-Houston Company, Ltd., of Rugby, have completed an illustrated list describing a new design of continuous-current motors and generators they are manufacturing. The pamphlet gives details of the construction of the machines, and also states the speeds, outputs and prices of motors from 27 to 155 horsepower, and of dynamos from 22 to 125 kilowatts. The machines are suitable for voltages between 200 and 550, and are made in the protected, enclosed ventilated, rain-proof, totally enclosed and flame-proof types, some of which are provided with a fan on the armature shaft to circulate the air and keep the winding cool. The enclosed ventilated and rain-proof motors are particularly suitable for driving machine tools and other machinery in situations where dust, particles of metal and other foreign matter might be liable to damage unprotected motors.

The "Acme" patent sawing machine for sawing steel, made by Charles Wicksteed & Company, Ltd., Stamford Road Works, Kettering, England, is the subject of an illustrated circular which the manufacturer is distributing. "These machines are constructed on sound mechanical principles, in every way similar to a first-class machine tool; are made massive and strong, and to resist any working strain likely to be put upon them. They are made in different sizes to suit various purposes, and a great quantity of work that is at the present time done on circular saws, milling machines and metal band-sawing machines can be done to great advantage, both in regard to speed and expense, on these patent sawing machines. The guides of the saw frame pivot on independent bearings, which are of ample proportion, and fixed far enough apart to insure absolute steadiness and to make them practically free from all wear and tear, the guides themselves in the case of the multiple saws being case-hardened. The saw frames of all machines are of malleable iron. On the 6-inch and all the girder saws the work can be sawn off at a slight angle both ways when held in the ordinary vice, the jaws of which swivel; and can be cut at any angle by removing the vice altogether and bolting direct on to the bed. There is a slot running the whole length of the bed for this purpose. The saw blade is lifted off its work on the return stroke by an oil ram. This enables a greater weight to be put on the saw and a greater and a greater accuracy to be attained than would otherwise be possible. Multiple and other heavy saws can be supplied with a hydraulic lift, which raises the saws up by power with the full weight on after the cut is completed, and lets them gently down on to the work again."

Motors and dynamos are the subject of a catalogue issued by J. H. Holmes & Company, Newcastle-on-Tyne. These machines are stated to have been designed on entirely new lines, and to embody all the latest improvements which are called for by experience and modern practice.

Siemens Bros. & Company, Ltd., of Caxton House, West minster, S. W., have sent us a copy of their Provisional Catalogue No. 532. This list contains full particulars with regard to their vulcanized india rubber, wires and cables, and gives full particulars and prices for all sizes of conductor. The present supersedes their main catalogue of V. I. R. cables, which was dated March, 1907.

Messrs. G. W. Clarke & Company (Liverpool), Ld., 17A South Castle street, recently published an illustrated catalogue of the Barry & Clarke temperature indicator and recorder. This consists of an electrical apparatus, which takes the form of a switchboard, and by its aid the temperature of each hold in a ship can be ascertained by placing special thermometers with electrical connections at the points under observation.

The Power Plant Company, Ltd., Temple Bar House, Fleet street, London, E. C., have recently issued an illustrated catalogue and price list of armored india rubber hose, etc.

Steel sheets, black and galvanized, plain and corrugated, are the subject of a pamphlet published by the Bowesfield Steel Company, Ltd., 110 Cannon street, London, E. C.

The India-Rubber, Gutta-Percha & Telegraph Works Company, Ltd., of Silvertown and 100-106 Cannon street, London, E. C., have published a beautifully printed booklet describing and illustrating "Silvertown" india rubber tiling or paving adapted for use aboard ships, yachts, etc.

Clarke's Crank & Forge Company, Ltd., of Lincoln, have issued a small catalogue illustrating a few examples of crankshafts which they manufacture. This firm supplies built-up, block and bent crankshafts up to 3 tons in weight, either black, rough-machined or finished bright. The examples illustrated include crankshafts for large pumps, portable engines, etc.

The General Electric Company, Ltd., 67 Queen Victoria street, E. C., have issued a batch of catalogues and advertising matter in connection with their productions. One of these catalogues deals with "Freezor" electric fans, giving prices and particulars of ceiling, port-hole, exhaust fans, and "Bandy" electric punkahs, all of which are supplied for continuous or alternating currents.

BUSINESS NOTES

AMERICA

THE EUREKA FIRE HOSE MANUFACTURING COMPANY, 13 Barclay street, New York, has made an addition to its already extensive plant of two-story brick concrete stable, and is also erecting a 75 by 100 brick carpenter shop.

TO FEEL KEEN AND ALERT, to think clearly and produce results, the man at the desk must have a positive supply of pure air. In order to bring about this result conveniently and economically, the American Blower Company, Detroit, Mich., has put on the market the "Sirocco" electric fan and air purifier. This is a device which is installed in the window sill, and the motive power can be obtained from any incandescent socket in the office.

MR. ALEXANDER HYND has severed his connection with the firm of Nacey & Hynd, Cleveland, Ohio, and has opened an office at 872 Rockefeller building, where he will continue business as a marine architect, consulting engineer and surveyor, and as representative for the Great Lakes of the American Bureau of Shipping. Mr. Hynd also continues his connection with the Sturrock patent cast iron bridge walls and other marine and steam engineering specialties.

THE LATEST ADDITION to the fleet of vessels owned by the city of New York is the *Hart's Island*, which recently had its trial trip in New York harbor. The *Hart's Island* is one of two small steamers entirely constructed by the Waters-Colver Company, West New Brighton, S. I. This steamer is 72 feet long, 17 feet wide and 8 feet depth of hold, with a tonnage of 66 gross tons, and a capacity of carrying 75 passengers. It is equipped with one compound condensing engine, with cylinders 9 by 18 inches; a 10-foot boiler, 66 inches in diameter, and with a capacity of 150 pounds steam pressure to the square inch. The trial trip of the *Hart's Island* proved her in every way a staunch, well-constructed and speedy harbor steamer. She will be used by the Department of Correction for freight and passengers from the city to the various penal institutions on Riker's Island and Hart's Island. The Waters-Colver Company has on its building ways two new tugs for the city of Philadelphia, and the steamer *Woodbine* for the Federal government.

A SPECIAL FIFTY-CENT OFFER.—The International Correspondence Schools, Box 1062, Scranton, Pa., is making a special 50-cent offer on some of its publications. The I. C. S. state that no books in existence contain in the same space so much knowledge about the different trades and professions as do these handbooks. They provide that data required in everyday work that is hard to find in ordinary books and that is inconvenient and sometimes impossible to carry in the memory. They are compiled from the regular courses of the International Correspondence Schools, and are said to have been written by the best experts in the country. These little books are, therefore, consulting experts of the highest ranks—pocket memorandums of inestimable value to the executive, foreman and manager. They are invaluable as promotion gainers for ambitious men in subordinate positions, because they can be easily understood without a knowledge of higher mathematics, and they contain just that information needed to secure promotion.

THE PROGRESS OF THE PARSONS MARINE TURBINE.—Full evidence of the increasing favor of the Parsons marine turbine is afforded by the annual report of the Parsons Marine Steam Turbine Company, Ltd. (New York office, 97 Cedar street). In it is stated that up to the present time the total horsepower of turbine engines completed and under construction in the works of the company and of licensees, as well as in the works of the Continental sub-companies and of licensees of Parsons' Foreign Patents Company, Ltd., amounts to 4,500,000 horsepower—an increase during the year of 1,250,000 horsepower. Of this total horsepower nearly 3,700,000 horsepower are, or will be, employed for the propulsion of warships, and over 800,000 horsepower in vessels of the mercantile marine and yachts. The British Admiralty took the lead in the introduction of the Parsons type of turbine into warships, and has continued to employ that type in nearly all the vessels laid down during the last five years. At present the total number of vessels built and building for the Royal navy and the Colonies with Parsons turbines is 143; the total horsepower is about 2,100,000. In all the important war fleets of the world the lead of the British Admiralty has been followed, and the Parsons type of turbine has been largely used in recent ships. The United States Navy Department, after making exhaustive trials of the Parsons turbine in the scout-cruiser *Chester*, in competition with the Curtis turbine fitted in the *Salem*, and reciprocating engines fitted in the *Birmingham* (sister ships of the *Chester*), adopted the Parsons type for the four large battleships now building and for fifteen destroyers. The French Ministry of Marine have adopted the Parsons turbine for all of the eight first-class battleships now building, and for ten torpedo vessels. In the German navy all the large armored cruisers recently laid down have Parsons turbines; that type has been adopted also for four protected cruisers and eight destroyers. The trials of the armored cruiser *Von Der Tann*, fitted with Parsons turbines, have proved most satisfactory, the speed attained on trial being 27½ knots, as against the speed of 25 knots said to have been contemplated when the design was prepared. In the Italian navy three large battleships, an armored cruiser, and three smaller vessels have Parsons turbines. The cruiser *San Marco* recently attained 22.9 knots on her speed trials, as against 21¾ knots attained by a sister ship fitted with reciprocating engines. Two first-class Austrian battleships now building and a scout cruiser recently completed have Parsons turbines; the latter vessel attained a speed of 27 knots on trial. In the Japanese navy four vessels are fitted with Parsons turbines. Spain is building three battleships, three destroyers and ten torpedo boats, for which the same type of engines has been adopted. Denmark, Sweden, Brazil, Argentina and China have also made use of Parsons turbines in recent war vessels. Experience on a very large scale in war vessels on actual service has now confirmed the favorable results obtained on the trials of turbine-driven ships. Equally satisfactory results have been obtained in vessels of the mercantile marine fitted with Parsons turbines. The French Trans-Atlantic Company have adopted Parsons turbines for their new steamship *La France*, recently launched, for which the speed of 23 knots is contemplated. The Japanese steamships *Tenyo Maru* and *Chiyo Maru*, propelled by Parsons turbines, have fully realized the intentions of their designer on their trans-Pacific service. It has been reported recently that orders have been given for a turbine-driven steamship for the service between England and New Zealand, and there is good reason for the belief that the Parsons type of turbine will be adopted to a very great extent for oceanic service in vessels of high speed in the mercantile marine. The "combination" system, devised by Mr. Parsons, in which low-pressure turbines are associated with reciprocating engines, is also being developed for mercantile steamships of comparatively moderate speeds, and has given very satisfactory results in working, especially as regards fuel economy. In the last report reference was made to the cargo steamer *Vespasian*, which had been purchased by the company, and was then being fitted with a system of geared turbines in order to demonstrate the possible economy in fuel, weight and space which that system of machinery would secure, as compared with the best types of reciprocating engines fitted in cargo steamers of low speed and great dead-weight capacity. Since these results were obtained the vessel has been continuously employed on ordinary sea service, carrying coals to Rotterdam and returning in water ballast. She has completed fourteen voyages and steamed 8,500 miles in all weathers. The results obtained on the first trials, as to relative economy in steam consumption when compared with reciprocating engines—namely, a reduction of 15 percent—have been confirmed by the data obtained on these voyages.—*London Engineering.*

Williamson Brothers' Company, Aramingo avenue and Cumberland street, Philadelphia, Pa., builders of steering engines and other marine machinery, announce that hereafter the entire marine product of the American Ship Windlass Company, Providence, R. I., builders of "Providence" windlasses, capstans and towing machines, will be sold from their Philadelphia office.

Edward A. Bunker, Postoffice Box 1579, New York, is distributing samples of "William Wilford" sail cloth. Mr. Bunker states: "The continued high price of cotton deserves your attention as to the merit of the Wilford Cloth, which has now been on the market for sixteen years. It is made of a twisted thread of pure flax, which renders it very strong, light and durable. It will not crack like cotton cloth, and has none of the objections which are made to cloth treated with paraffine, oil or paint, which is a great advantage, and makes it well worth a trial as to its merits. After using a heavy grade of cotton cloth, such as a No. 1, 2 or 3 cotton cloth, it is difficult to make people believe that a cloth can be light as to weight and at the same time be water repellent, and having nearly double the strength of cotton it therefore has much greater durability."

Friction Losses.—What tests and experience show when Dixon's flake graphite is added to the lubricant: "Scientific tests by prominent authorities have proved that friction losses are much reduced and the carrying capacity of the bearings greatly increased when the lubricant contains the correct proportions of Dixon's pure flake lubricating graphite, and these tests are proved by actual experiences. Sometime ago Prof. W. F. M. Goss, Dean of the College of Engineering, University of Illinois, made some tests with the Dixon pure flake lubricating graphite on ball bearings. As a result of these tests, Prof. Goss says, in part, that the following conclusions may be drawn: 'A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard oil alone will do, and which at the same time will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry. An oil as light as kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium heavy pressure. Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearings to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used. The admixture of graphite with either a liquid or viscous lubricant serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry.' The Joseph Dixon Crucible Company, Jersey City, N. J., has a record of Prof. Goss' extensive tests with graphite as a lubricant published in pamphlet form, under the title of *A Study in Graphite*, which is sent free on request."

Be Careful of Your Decks.—"You can scrape your decks down to the wood, sandpaper them down to a glass finish, and then rub down between each coat of varnish that you put on, and flatter yourself that you made a good job of it. And, then, the first thing you know, along comes a hot, dry spell, the strips of the deck shrink, and the composition of putty, wood filler and various other things that are so often used to fill in places between the strips cracks and loosens. Then, the next time the deck gets wet the strips swell and squeeze out the loosened putty, and all your toil has been for naught, as far as the appearance of that deck is concerned. There has, to date, been discovered just one composition that will stay in the deck seam for an entire season, no matter to what degree of alternate wetness and dryness, cold and heat the decks are subjected, and this composition is Jeffery's Patent Marine Yacht Glue, and the secret of the longevity of its usefulness lies in its elasticity, which allows it to be compressed or expanded without leaving the sides of the seam in which it is placed. The glue is made in black, white, yellow and also a mahogany color. The white, yellow and mahogany look pretty, but the black glue is the best, and is guaranteed by the makers to be the really genuine original sticker that relieves the owner's mind of all care, as far as his seams are concerned. It is a mighty good idea for the boat owner when specifying work to be done on his boat toward getting her into commission for next year, to specify that Jeffery's Marine Yacht Glue be used to pay the deck seams, or if he intends doing it himself to write to L. W. Ferdinand & Co., 201 South street, Boston, Mass., for a sample of the glue and directions for applying same. These directions are a mighty important item, as, while very simple and easily followed, they must be followed if the best results are to be obtained."

BUSINESS NOTES

GREAT BRITAIN

A REVISED SPECIFICATION for structural steel for shipbuilding has been issued by the Engineering Standards Committee. In this revision the maximum tensile strength for plates intended for cold flanging has been reduced from 32 to 30 tons per square inch. No alterations have been made to the lower limit of tensile strength nor to the elongation. Provision is made in the revised specification for the use of the four-diameter test piece for bars above 1 inch in diameter, whether they are tested full size as rolled or whether they have been turned down.

MESSRS. DAVID WILSON'S PATENT NOISELESS WINCH COMPANY, of Liverpool, are at present executing a large number of orders for owners of passenger and cargo steamers alike for their special winches. Among recent orders are those for ten Nelson liners and for three ships recently constructed at Earle's shipbuilding yard, Hull, all of which are fully equipped with David Wilson's winches. Full particulars and an illustration of these winches were included in our issue of July last. As we pointed out then the most striking feature of the Wilson winch is that it is quite noiseless, a result attained by the substitution of sprocket wheels and chains in place of the usual and noisy method of direct coupling of the gear wheels. The chains operate on three-fourths of the main barrel wheel, thus distributing the weight nearly all over this wheel, instead of working with one tooth as in the ordinary winch. The makers claim that with a steam pressure of 40 pounds their winch will lift as much as the ordinary apparatus working at 60 pounds. The chains are of the roller type, in which the wear comes entirely on the whole length of the pin, and are case-hardened and tested to 15 tons breaking strain. The patentees have gone even further and devised a compound roller chain, which has been tested to a strain of 32 tons, thus still further ensuring even tension, more direct drive and absence of noise and vibration. The noiseless type of winch seems likely in the course of time to displace to a large extent those more commonly in use, more especially as the improvements can be fitted to the ordinary steam winch at a very moderate cost, and without necessitating its removal from the ship's deck.

MESSRS. FORREST & COMPANY, of Wivenhoe, Essex, recently built a large houseboat for Baron Barreto. This vessel, which is called the *Sea King*, measures 146 feet over all by 22 feet beam, and is intended for harbor work, no propelling machinery being fitted. Cabins and staterooms are built on the main deck, with a promenade deck above. Further accommodation for the owner and visitors is arranged below, together with quarters for the captain and crew. Electric light is installed throughout, current being generated by a steam dynamo. One mast is fitted amidships, with a derrick and steam winches for raising a steam launch and other boats.

AN INTERNATIONAL CONFERENCE, with the object of rendering submarine vessels more safe to their crews. Herr Em. Starkmann, Münchenerstr. 14, Berlin W. 30, Germany, writes INTERNATIONAL MARINE ENGINEERING as follows: "The more and more numerous accidents happening lately to submarine boats, the insufficiency of means for safety and the extreme difficulties which have opposed their appliance have caused me to propose an international conference, to which should be invited the best-known constructors of submarine vessels as well as a submarine-boat commander of every State having such boats in use. This conference shall be held at Berlin in the near future, and it shall be the object of the meeting to consider, for the best of the brave officers and crews of such boats, just what kinds of means for saving the crew of submarine vessels in time of dangers are already known; how these means have proved themselves so far, and, above all, to deliberate in what manner they may be improved upon. Furthermore, I wish by the publication of this project in all professional journals of the world to call the attention of those officers and technical experts who interest themselves in solving the problem for safety means for submarine vessels, to this conference, where their propositions would be discussed. The personal information gained through interested parties has proved to me that the idea finds much sympathy, and therefore I would ask you, Mr. Editor, to kindly support my project by publishing it in your much esteemed paper, and also by continuing to assist me in my endeavors. When publishing your communication, I would respectfully ask you to add: that all the letters regarding this conference, as well as propositions and other details concerning safety apparatus a. s. o., should be sent to my address."

HELP AND SITUATION AND FOR SALE ADVERTISEMENTS

No advertisements accepted unless cash accompanies the order.

Advertisements will be inserted under this heading at the rate of 4 cents (2 pence) per word for the first insertion. For each subsequent consecutive insertion the charge will be 1 cent (½ penny) per word. But no advertisement will be inserted for less than 75 cents (3 shillings). Replies can be sent to our care if desired, and they will be forwarded without additional charge.

Manager for New York Sales Office.—A Detroit concern desires the services of a high-class man, having large acquaintance among marine engineers and buyers of marine engineering apparatus. Must also be familiar with boilers and their equipment. Reply in full. Box 70, care International Marine Engineering.

Messrs. H. & C. Grayson, Ltd., the manufacturers of steam boilers, etc., are making considerable progress with McKay's patent instantaneous engaging and disengaging gear for ships' boats, of which they are the sole makers. At the present time they have a large number of orders in hand, including, among others, equipments for vessels of the Cunard Line. A large number of foreign firms have also placed orders with Messrs. Grayson. The claims made for this type of boat gear over others are that its construction is simple and entirely without complicated mechanism, it is always ready for immediate use, the stem and stern being simultaneously disengaged, it can be used in the roughest seas, and it cannot become disengaged until the boat is waterborne, while the cost is so small that it must commend itself to all shipowners, shipbuilders and superintendents. The device, which has been approved by the Board of Trade, has proved its merits as an extremely reliable gear.

Messrs. E. A. Reine & Company, of Helsingfors, Finland, the Russian agents of Messrs. John I. Thornycroft & Company, have recently built, to the order of the Railway Department of the Russian government, a motor hospital boat which is primarily intended for the use of the medical officer in the Wilna district of Russia, where she will be employed in transferring patients suffering from cholera from the outlying districts to the hospitals. The vessel is 42 feet long by 9 feet in beam, and draws only 16 inches of water, loaded, so that she can get into the shallowest streams. The hull, which is built of yellow pine with oak timbers, is divided into six compartments. Of the two forward ones, the first contains a paraffine tank of 100 gallons capacity and chain locker, and the second is the engine room, fitted with a 36-horsepower Thornycroft paraffine engine and equipment, with sleeping accommodation for the crew. Next comes the open cockpit, containing the steering gear, followed by a roomy saloon, for the use of the medical officers. Aft of this a short alleyway extends to the watertight bulkhead, which isolates the hospital space in the stern from the rest of the boat. This compartment has accommodation for six patients, and is warmed by radiators fed by exhaust-heated water, and ventilated by a large skylight. The boat, which has a speed of 10 knots under working conditions, was delivered under her own power at Reval early in the present month, and is now actively engaged in the Wilna district.

We understand that the Imperial Light, Ltd., of 123 Victoria street, London, gave an interesting exhibition in Wallsend recently of their system of lights for loading and discharging cargo; and the numerous superintendents and others present expressed their appreciation of the efficiency, simplicity and cheapness of the installation. The system fitted on board the India Line steamer the *Indrabarah* consists of powerful lights on each of the four masts for lighting the decks and holds, together with four portable lights, which may be fixed to the ship's sides, for lighting the deck side or barges alongside. These lights are supplied from portable generators about 3 feet 6 inches high and 36 inches diameter, which stand at the foot of the masts, and are connected to special fixed piping running up the masts for about 25 feet to the burner arms, which are carried on brackets connected in the same way to the fixed piping. These burner arms and generators can be removed and stowed away when not required. The flame is absolutely wind-proof, and the light can be thrown in any direction. Each burner is of 1,500 candlepower, and the generators are designed to run these lights for about eight hours. By means of the portable lights it was possible to throw a light anywhere in the holds, and with the mast lights it was also possible to throw a light as far as some buildings on the opposite side of the river. The company, in addition, showed a number of small hand lamps for use in the engine room or for examining any part of the decks or holds. The *Indrabarah*, it is interesting to note, is the third vessel equipped by the Imperial Light, Ltd., for the same owners

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Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
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NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS.
314 Madison Avenue, New York City.

UNITED STATES NAVAL INSTITUTE.
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Yarrow & Company, Ltd., Scotstoun, near Glasgow, have received an order from Buenos Ayres for a high-speed motor boat. This vessel will be 60 feet long by 9 feet beam; propelled by five sets of internal combustion engines of the Yarrow-Napier design, of approximately 300 horsepower. Her speed will be about 25½ knots.

Dexine Works, Stratford, London, E., state that this company's "Dexine" packing has been adopted by the British Admiralty, and is in use, among many other vessels, on H. M. S. *Terrible*. "It will not blow, burn or squeeze out. It is not affected by steam temperature of 670 degrees F., and is therefore suitable for dry or superheated steam. Is equally well adapted for air, water, ammonia, acids, gases and all kinds of work at the very highest temperatures and pressures in use. Does not lose its elasticity, which is the primary cause of most joints blowing out, and is therefore able to withstand increased strains with varying temperatures. Joints may be opened up as desired, using the same gasket over and over again. Is especially well adapted for long lengths of steam piping to auxiliary machinery, subject to condensation, water, hammering and unequal expansion. It is a fully guaranteed all-round jointing."

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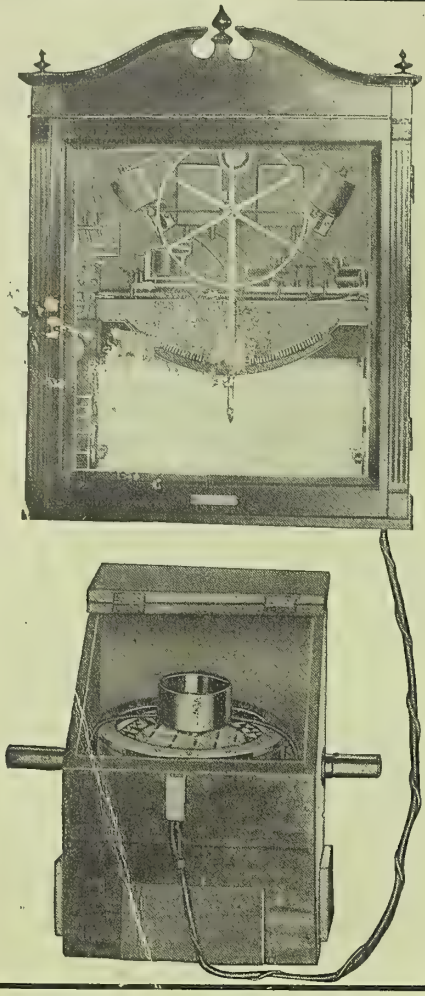

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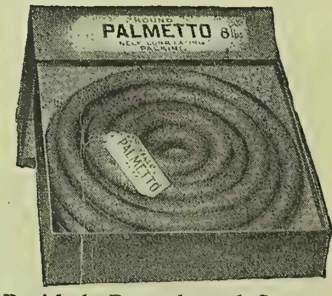

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